Cyrene: A Bio-based Solvent for the Mizoroki-Heck Reaction of Aryl Iodides

Naya A. Stini,[†] Petros L. Gkizis,[†] Christoforos G. Kokotos*

Laboratory of Organic Chemistry, Department of Chemistry, National and Kapodistrian University of Athens, Panepistimiopolis, Athens 15771, Greece

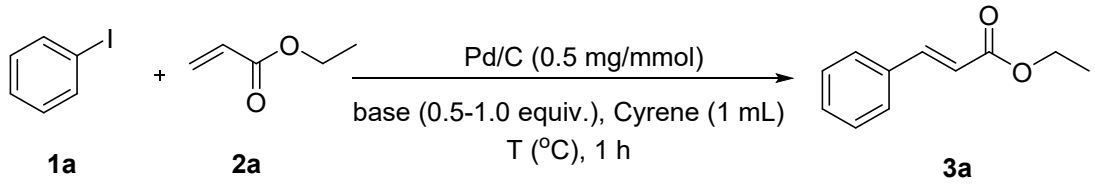
Centre of Excellence for Drug Design and Discovery, National and Kapodistrian University of Athens, Panepistimiopolis 15771, Athens, Greece

SUPPORTING INFORMATION

General Remarks

Chromatographic purification of products was accomplished using forced-flow chromatography on Merck® Kiesel gel 60 F_{254} 230-400 mesh. Thin-layer chromatography (TLC) was performed on aluminum backed silica plates (0.2 mm, 60 F_{254}). Visualization of the developed chromatogram was performed by fluorescence quenching using phosphomolybdic acid, anisaldehyde or potassium permanganate stains. Melting points were determined on a Buchi® 530 hot stage apparatus and are uncorrected. Mass spectra (ESI) were recorded on a Finningan® Surveyor MSQ LC-MS spectrometer. HRMS spectra were recorded on Bruker® Maxis Impact QTOF spectrometer. ^{1}H-NMR, ^{19}F-NMR and ^{13}C-NMR spectra were recorded on an Avance Neo Bruker 400 MHz (400 MHz, 376 MHz and 100 MHz, respectively) and are internally referenced to residual solvent signals. Data for ^{1}H-NMR are reported as follows: chemical shift (δ ppm), integration, multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, quint = quintet, m = multiplet, br s = broad signal), coupling constant and assignment. Data for ^{19}F-NMR are reported in terms of chemical shift (δ ppm) and are internally referenced to fluoroform (376 MHz). Data for ^{13}C-NMR are reported in terms of chemical shift (δ ppm). Mass spectra and conversions of the reactions were recorded on a Shimadzu® GCMS-QP2010 Plus Gas Chromatograph Mass Spectrometer utilizing a MEGA® column (MEGA-5, F.T.: 0.25 μm, I.D.: 0.25 mm, L: 30 m, T_{max}: 350 ^{o}C, Column ID# 11475). Optical rotations were measured in an AA-65 Automatic Polarimeter.

Optimization of the Reaction Conditions for the Green and Sustainable Mizoroki-Heck Reaction in Cyrene



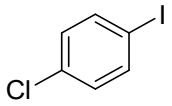
1a **2a** **3a**

Entry	Base	Base (equiv.)	Temp (°C)	Yield (%)[a]
1	Et_3N	0.75	50	5
2	Et_3N	0.75	80	25
3	Et_3N	1.0	80	28
4	Et_3N	0.75	150	88
5[b]	Et_3N	0.75	150	0
6[c]	Et_3N	0.75	150	75
7	Et_3N	0.5	150	69
8	**Et_3N**	**1.0**	**150**	**96 (86)**
9[d]	Et_3N	1.0	150	95 (85)
10	DIPEA	1.0	150	78
11	AcONa	1.0	150	27
12	K_2CO_3	1.0	150	86
13	K_2CO_3	0.75	150	85
14	K_2CO_3	0.5	150	62

[a] Yield was determined by ^{1}H-NMR, using internal standard. Yield of **3a** after purification by column chromatography is presented in parenthesis. The reaction was performed with iodobenzene (**1a)** (204 mg, 1.00 mmol), ethyl acrylate **2a** (120 mg, 1.20 mmol), base (0.50-1.00 equiv.) and 10% w/w Pd/C (0.5 mg) in Cyrene (1 mL) for 1 h. [b] The reaction was performed in the absence of Pd/C. [c] The reaction was performed in Cyrene (0.5 mL). [d] The reaction was performed using 10% w/w Pd/C (1 mg) in Cyrene (2 mL).

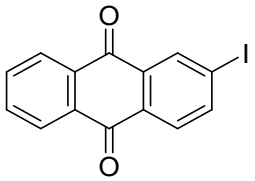
Synthesis of Starting Materials

1-Chloro-4-iodobenzene (1b)[1]



4-Chloroaniline (1.27 g, 1.0 equiv., 10.00 mmol) was diluted in aqueous HCl (50 mL, 2.5 M) at 0 °C. The reaction mixture was left stirring at 0 °C for 10 minutes. A solution of $NaNO_2$ (0.73 g, 1.06 equiv., 10.60 mmol) in H_2O (5 mL) was added dropwise and the reaction mixture was left under stirring at 0 °C for 30 minutes. A precooled (at 0 °C) solution of NaI (1.80 g, 1.2 equiv., 12.00 mmol) in H_2O (10 mL) was added to the reaction mixture. Upon addition, the reaction mixture turned to a dark brown color. The reaction mixture was left stirring at room temperature for 18 h. Ethyl acetate (30 mL) was added, and the organic layer was separated. The aqueous layer was washed with ethyl acetate (3 x 30 mL). The organic layers were combined, dried over Na_2SO_4 and concentrated *in vacuo*. Ethyl acetate (30 mL) was added to the oily residue, and the reaction mixture was washed with aqueous 10% w/w $Na_2S_2O_3$ (3 x 30 mL), dried over Na_2SO_4 and concentrated *in vacuo*. The crude mixture was further purified by column chromatography on silica gel (Pet. Ether). Yield **61%**; Pink oil; NMR data in accordance with reported literature;[1] **^{1}H NMR** (400 MHz, $CDCl_3$) *δ:* 7.66-7.59 (2H, d, *J* = 8.4 Hz, ArH), 7.14-7.10 (2H, d, *J* = 8.4 Hz, ArH); **^{13}C NMR** (100 MHz, $CDCl_3$) *δ*: 139.7, 134.4, 130.5, 91.3; **MS (ESI)** m/z 239 $[M+H]^+$.

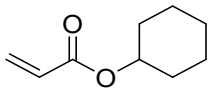
2-Iodoanthracene-9,10-dione (1m)[2]



2-Iodoanthracene-9,10-dione was synthesized using the same procedure as for **1b**. Yield: **83%**; Orange solid; m.p.: 163-165 °C; NMR data in accordance with reported literature;[2] **^{1}H NMR** (400 MHz, $CDCl_3$) *δ*: 8.86 (1H, d, *J* = 1.8 Hz, ArH), 8.36-8.29 (2H, m, ArH), 8.17 (1H, dd, *J* = 8.2 and 1.8 Hz, ArH), 8.01 (1H, d, *J* = 8.2 Hz, ArH), 7.86-7.81 (2H, m, ArH); **^{13}C NMR** (100 MHz, $CDCl_3$) *δ:* 182.7, 182.0, 143.1, 136.3,

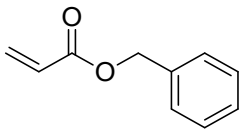
134.3, 134.4, 134.0, 133.3, 133.0, 132.6, 128.7, 127.3, 127.3, 102.2; **MS (ESI)** m/z 334 $[M]^+$.

Cyclohexyl acrylate (2o)[3]



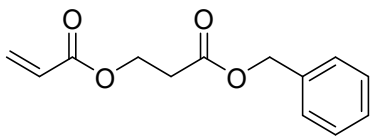
To a stirring solution of cyclohexanol (1.00 g, 1.00 equiv., 10.00 mmol) and triethylamine (2.75 mL, 2.0 equiv., 20.00 mmol) in THF (10 mL) at -30 °C, acroyl chloride (0.80 mL, 1.00 equiv., 10.00 mmol) was added dropwise over 20 min. The reaction mixture was stirred for 2 h, the reaction mixture was concentrated *in vacuo*. The residue was dissolved in ethyl acetate (15 mL) and washed with water (15 mL) and brine (15 mL), dried over Na_2SO_4 and concentrated *in vacuo*. The crude reaction mixture was purified by column chromatography (Pet. Ether). Yield **80%**; Colorless oil; NMR data in accordance with reported literature;[3] **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 6.40 (1H, dd, J = 17.3 and 1.5 Hz, =CH*H*), 6.12 (1H, dd, J =17.3 and 10.4 Hz, =CH), 5.80 (1H, dd, J = 10.4 and 1.5 Hz, =C*H*H), 4.95-4.75 (1H, m, OCH), 1.94-1.85 (2H, m, 2 x C*H*H), 1.80-1.70 (2H, m, 2 x C*H*H), 1.60-1.26 (6H, m, 6 x C*H*H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 165.7, 130.0, 129.2, 72.7, 31.6, 25.4, 23.7; **MS (ESI)** m/z 334 $[M]^+$.

Benzyl acrylate (2p)[4]



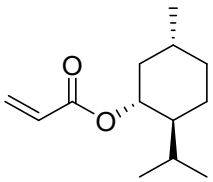
Compound **2p** was synthesized using the same procedure as for **2o**. Yield **86%**; White solid; m.p.: 61-63 °C; NMR data in accordance with reported literature;[4] **^{1}H NMR** (400 MHz, $CDCl_3$) δ*:* 7.44-7.34 (5H, m, ArH), 6.47 (1H, d, J = 17.3 Hz, =C*H*H), 6.19 (1H, dd, J = 17.3 and 10.4 Hz, =CH), 5.79 (1H, d, J = 10.4 Hz, =C*H*H), 5.20 (2H, s, OCH_2Ph); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 166.0, 135.8, 131.0, 128.5, 128.4, 128.2, 66.3; **MS (ESI)** m/z 163 $[M+H]^+$.

3-(Benzyloxy)-3-oxopropyl acrylate (2q)



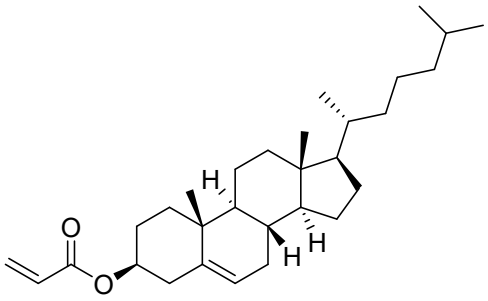
Compound **2q** was synthesized using the same procedure as for **2o**. Yield **71%**; Colorless oil; **^{1}H NMR** (400 MHz, $CDCl_3$) *δ:* 7.40-7.32 (5H, m, ArH), 6.39 (1H, d, *J* = 17.3 Hz, =C*H*H), 6.09 (1H, dd, *J* = 17.3 and 10.4 Hz, =CH), 5.82 (1H, d, *J* = 10.4 Hz, =C*H*H), 5.18 (2H, s, OCH_2Ph), 4.47 (2H, t, *J* = 6.3 Hz, OCH_2), 2.76 (2H, t, *J* = 6.3 Hz, CH_2CO); **^{13}C NMR** (100 MHz, $CDCl_3$) *δ*: 170.4, 165.7, 135.6, 131.0, 128.5, 128.1, 128.2, 128.0, 66.5, 59.8, 33.8; **HRMS** exact mass calculated for $[M+Na]^+$ ($C_{13}H_{14}O_4Na^+$) requires *m/z* 257.2484, found *m/z* 257.2486.

(*1R,2S,5R*)-2-Isopropyl-5-methylcyclohexyl acrylate (2v)[5]



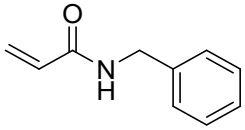
Compound **2v** was synthesized using the same procedure as for **2o**. Yield **75%**; Orange oil; $[\alpha]_D$ -72.0 (*c* 0.92 in $CHCl_3$); NMR data in accordance with reported literature;[5] **^{1}H NMR** (400 MHz, $CDCl_3$) *δ*: 6.39 (1H, d, *J* = 17.3 Hz, =C*H*H), 6.11 (1H, dd, *J* = 17.3 and 10.4 Hz, =CH), 5.80 (1H, d, *J* = 10.4 Hz, =C*H*H), 4.77 (1H, td, *J* = 10.9 and 4.4 Hz, OCH), 2.08-1.99 (1H, m, CH), 1.93-1.83 (1H, m, CH), 1.75-1.64 (2H, m, 2 x C*H*H), 1.56-1.37 (2H, m, 2 x C*H*H), 1.16-0.97 (2H, m, 2 x C*H*H), 0.94-0.85 (7H, m, 2 x CH_3 and CH), 0.78 (3H, d, *J* = 7.0 Hz, CH_3); **^{13}C NMR** (100 MHz, $CDCl_3$) *δ*: 165.8, 130.1, 129.0, 74.3, 47.1, 40.8, 34.2, 31.3, 26.3, 23.5, 22.0, 20.7, 16.4; **MS (ESI)** m/z 233 $[M+Na]^+$.

Cholesteryl acrylate (2w)[6]



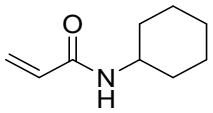
Compound **2w** was synthesized using the same procedure as for **2o**. Yield **48%**; Pale yellow solid; m.p.: 125-126 °C; $[\alpha]_D$ -33.0 (*c* 0.31 in $CHCl_3$); NMR data in accordance with reported literature;[6] **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 6.41 (1H, dd, *J* = 17.4 and 1.5 Hz, =C*H*H), 6.12 (1H, dd, *J* = 17.3 and 10.4 Hz, =CH), 5.82 (1H, dd, *J* = 10.4 and 1.5 Hz, =CH*H*), 5.41 (1H, d, *J* = 4.5 Hz, =CH), 4.71 (1H, dt, *J* = 11.2 and 8.0 Hz, OCH), 2.44-0.99 (31H, m, CH_3, 6 x CH and 22 x CH*H*), 0.94 (3H, d, *J* = 6.5 Hz, CH_3), 0.89 (3H, d, *J* = 6.5 Hz, CH_3), 0.89 (3H, d, *J* = 6.5 Hz, CH_3), 0.68 (3H, s, CH_3); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 165.6, 139.6, 130.2, 129.0, 122.7, 74.1, 56.7, 56.1, 50.0, 42.3, 39.7, 39.5, 38.1, 37.0, 36.6, 36.2, 35.8, 31.9, 31.9, 28.2, 28.0, 27.8, 24.3, 23.8, 22.8, 22.5, 21.0, 19.3, 18.7, 11.8; **MS (ESI)** m/z 458 $[M+NH_4]^+$.

***N*-Benzylacrylamide (2x)**[7]



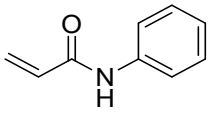
Compound **2x** was synthesized using the same procedure as for **2o**. Yield **87%**; White solid; m.p.: 60-64 °C; NMR data in accordance with reported literature;[7] **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.40-7.27 (5H, m, ArH), 6.31 (1H, d, *J* = 17.0 Hz, =C*H*H), 6.27-6.18 (1H, br s, NH), 6.15 (1H, dd, *J* = 17.0 and 10.2 Hz, =CH), 5.66 (1H, d, *J* = 10.2 Hz, =C*H*H), 4.51 (2H, s, NCH_2Ph); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 166.5, 138.0, 130.6, 128.7, 127.8, 127.5, 126.7, 43.6; **MS (ESI)** m/z 162 $[M+H]^+$.

_N_-Cyclohexylacrylamide (2y)[7]



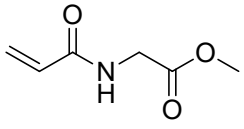
Compound **2z** was synthesized using the same procedure as for **2o**. Yield **78%**; Yellowish solid; m.p.: 109-111 °C; NMR data in accordance with reported literature;[7] **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 6.27 (1H, d, J = 16.9 Hz, =C*H*H), 6.09 (1H, dd, J = 16.9 and 10.3 Hz, =CH), 5.62 (1H, d, J = 10.3 Hz, =C*H*H), 4.55-4.42 (1H, br s, NH), 3.92-3.80 (1H, m, NCH), 2.01-1.92 (2H, m, 2 x C*H*H), 1.78-1.70 (2H, m, 2 x C*H*H), 1.70-1.59 (1H, m, C*H*H), 1.45-1.35 (2H, m, 2 x C*H*H), 1.23-1.12 (3H, m, 3 x C*H*H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 164.6, 131.3, 126.0, 48.2, 33.1, 25.5, 24.8; **MS (ESI)** m/z 154 $[M+H]^+$.

_N_-Phenylacrylamide (2z)[8]



Compound **2z** was synthesized using the same procedure as for **2o**. Yield **91%**; White solid; m.p.: 102-104 °C; NMR data in accordance with reported literature;[8] **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.74-7.66 (1H, br s, NH), 7.60 (2H, d, J = 7.5 Hz, ArH), 7.35 (2H, t, J = 7.5 Hz, ArH), 7.14 (1H, t, J = 7.5 Hz, ArH), 6.45 (1H, d, J = 16.9 Hz, =C*H*H), 6.29 (1H, dd, J = 16.9 and 10.1 Hz, =CH), 5.78 (1H, d, J = 10.1 Hz, =C*H*H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 163.7, 137.8, 131.2, 129.0, 127.7, 124.5, 120.0; **MS (ESI)** m/z 148 $[M+H]^+$.

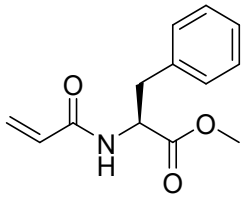
Methyl 2-acrylamidoacetate (2ab)[9]



Compound **2ab** was synthesized using the same procedure as for **2o**. Yield **79%**; Pale orange solid; m.p.: 73-75 °C; NMR data in accordance with reported literature;[9] **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.06-6.85 (1H, br s, NH), 6.28-6.13 (2H, m, =C*H*H and

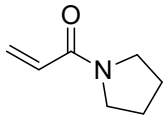
=CH), 5.62 (1H, d, *J* = 9.6 Hz, =C*H*H), 4.04 (2H, d, *J* = 5.5 Hz, NCH_2), 3.69 (3H, s, OCH_3); **^{13}C NMR** (100 MHz, $CDCl_3$) *δ*: 170.2, 165.8, 130.0, 126.9, 52.1, 41.0; **MS (ESI)** m/z 143 [M^+].

(*S*)-Methyl 2-acrylamido-3-phenylpropanoate (2ac)[10]



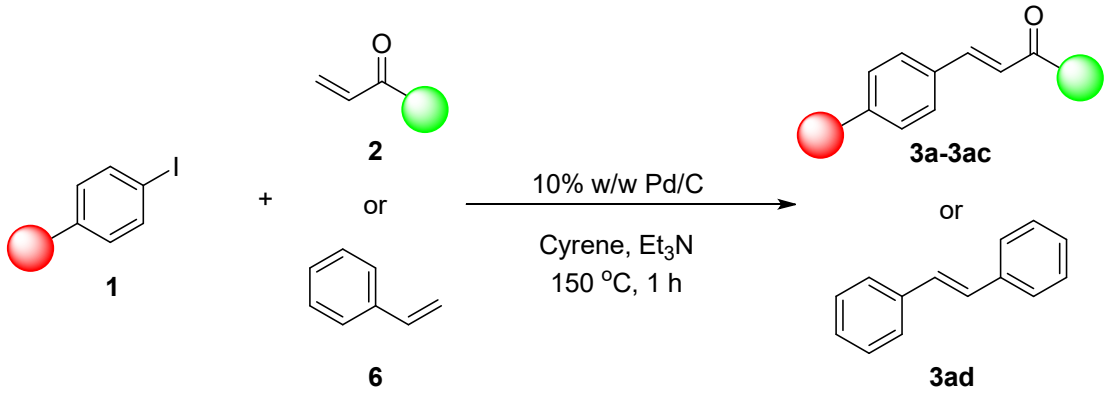
Compound **2ab** was synthesized using the same procedure as for **2o**. Yield **83%**; White solid; m.p.: 81-83 °C; $[\alpha]_D$ -29.0 (*c* 0.52 in $CHCl_3$); NMR data in accordance with reported literature;[10] **^{1}H NMR** (400 MHz, $CDCl_3$) *δ*: 7.29-7.17 (3H, m, ArH), 7.13-7.06 (2H, m, ArH), 6.66-6.54 (1H, br s, NH), 6.24 (1H, d, *J* = 17.0 Hz, =C*H*H), 6.10 (1H, dd, *J* = 17.0 and 10.1 Hz, =CH), 5.59 (1H, d, *J* = 10.1 Hz, =C*H*H), 4.97-4.88 (1H, m, NCH), 3.68 (3H, s, OCH_3), 3.15 (1H, dd, *J* = 13.8 and 5.8 Hz, C*H*HPh) 3.06 (1H, dd, *J* = 13.8 and 5.8 Hz, C*H*HPh); **^{13}C NMR** (100 MHz, $CDCl_3$) *δ*: 171.9, 164.9, 135.8, 130.1, 129.0, 128.3, 126.8, 53.3, 52.3, 37.5; **MS (ESI)** m/z 234 $[M+H]^+$.

1-(Pyrrolidin-1-yl)prop-2-en-1-one (2ae)[11]



Compound **2ad** was synthesized using the same procedure as for **2o**. Yield **76%**; Yellow oil; NMR data in accordance with reported literature;[11] **^{1}H NMR** (400 MHz, $CDCl_3$) *δ*: 6.45-6.26 (2H, m, =CH and =C*H*H), 5.61 (1H, d, *J* = 10.0 Hz, =C*H*H), 3.53-3.43 (4H, m, 4 x NC*H*H), 1.96-1.78 (4H, m, 4 x C*H*H); **^{13}C NMR** (100 MHz, $CDCl_3$) *δ*: 164.2, 128.6, 127.1, 46.4, 45.7, 25.9, 24.1; **MS (ESI)** m/z 126 $[M+H]^+$.

General Procedure for the Mizoroki-Heck Cross Coupling Reaction in Cyrene

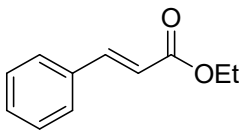


In a screw capped tube, aryl iodide (1.00 mmol, 1.00 equiv.), acrylate (1.20 mmol, 1.20 equiv.), triethylamine (TEA) (138 μL, 1.00 mmol, 1.00 equiv.), Cyrene (1 mL) and 10% w/w Pd/C (0.5 mg) were added consecutively. The screw capped tube was sealed with a cap and Teflon and was left under stirring at 150 °C for 1-18 hours. The reaction was monitored using thin layer chromatography (TLC). After reaction completion, the reaction mixture was filtered through a Celite pad. The filtrate was diluted with water (2.5 mL) and EtOAc (2.5 mL) was added. The organic layer was separated and dried over Na_2SO_4. After filtration, the organic solvent was removed *in vacuo*. The desired product was isolated via purification by column chromatography.

A **B** **C**

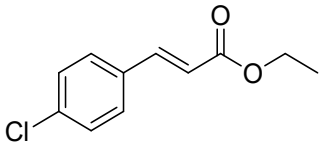
A. Reaction mixture before the reaction set-up; **B.** Reaction mixure heated at 150 °C; **C.** Reaction mixture after reaction completion.

Ethyl cinammate (3a)[12]



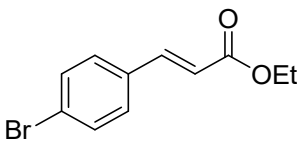
The desired product was synthesized following the General Procedure. Reaction time: 1 h; Yield **86%**; Colorless oil; NMR data in accordance with reported literature;[12] **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.68 (1H, d, J = 16.0 Hz, =CH), 7.54-7.45 (2H, m, ArH), 7.37-7.29 (3H, m, ArH), 6.43 (1H, d, J = 16.0 Hz, =CH), 4.25 (2H, q, J = 7.1 Hz, OCH_2), 1.32 (3H, t, J = 7.1 Hz, CH_3); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 166.6, 144.3, 134.2, 129.9, 128.6, 127.8, 118.0, 60.1, 14.0; **MS (ESI)** m/z 177 $[M+H]^+$.

(*E*)-Ethyl 3-(4-chlorophenyl)acrylate (3b)[13]



The desired product was synthesized following the General Procedure. Reaction time: 1 h; Yield **78%**; Yellowish oil; NMR data in accordance with reported literature;[13] **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.63 (1H, d, J = 16.0 Hz, =CH), 7.45 (2H, d, J = 8.6 Hz, ArH), 7.35 (2H, d, J = 8.6 Hz, ArH), 6.40 (1H, d, J = 16.0 Hz, =CH), 4.27 (2H, q, J = 7.1 Hz, OCH_2), 1.34 (3H, t, J = 7.1 Hz, CH_3); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 166.6, 143.0, 136.0, 132.9, 129.1, 129.1, 118.8, 60.5, 14.2; **MS (ESI)** m/z 211/213 $[M+H]^+$.

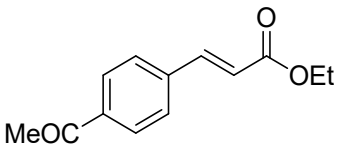
(*E*)-Ethyl 3-(4-bromophenyl)acrylate (3c)[13]



The desired product was synthesized following the General Procedure. Reaction time: 1 h; Yield **87%**; Colorless oil; NMR data in accordance with reported literature;[13] **^{1}H**

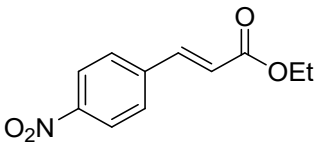
NMR (400 MHz, $CDCl_3$) δ: 7.60 (1H, d, J = 16.0 Hz, =CH), 7.49 (2H, d, J = 8.4 Hz, ArH), 7.36 (2H, d, J = 8.4 Hz, ArH), 6.41 (1H, d, J = 16.0 Hz, =CH), 4.26 (2H, q, J = 7.1 Hz, OCH_2), 1.33 (3H, t, J = 7.1 Hz, CH_3); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 166.5, 143.0, 133.2, 131.9, 129.2, 124.3, 118.8, 60.4, 14.2; **MS (ESI)** m/z 254/256 $[M+H]^+$.

(*E*)-Ethyl 3-(4-acetylphenyl)acrylate (3d)[14]



The desired product was synthesized following the General Procedure. Reaction time: 2 h; Yield **55%**; Yellow solid; m.p.: 36-38 ^{o}C; NMR data in accordance with reported literature;[14] **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.98 (2H, d, J = 8.2 Hz, ArH), 7.71 (1H, d, J = 16.0 Hz, =CH), 7.62 (2H, d, J = 8.2 Hz, ArH), 6.54 (1H, d, J = 16.0 Hz, =CH), 4.29 (2H, q, J = 7.1 Hz, OCH_2), 2.63 (3H, s, $COCH_3$), 1.36 (3H, t, J = 7.1 Hz, CH_3); **^{13}C NMR** (100 MHz, $CDCl_3$) δ*:* 197.3, 166.5, 143.0, 138.7, 137.9, 128.8, 128.1, 120.8, 60.7, 26.7, 14.2; **MS (ESI)** m/z 218 $[M+H]^+$.

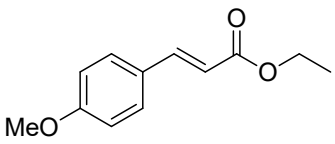
(*E*)-Ethyl 3-(4-nitrophenyl)acrylate (3e)[13]



The desired product was synthesized following the General Procedure. Reaction time: 1 h; Yield **76%**; (E/Z 95:5); White solid; m.p.: 106-108 ^{o}C; NMR data in accordance with reported literature;[13] **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 8.36 (0.1H, d, J = 8.9 Hz, ArH), 8.25 (1.9H, d, J = 8.9 Hz, ArH), 7.80 (0.1H, d, J = 8.9 Hz, ArH), 7.75-7.65 (2.85H, m, ArH and =CH), 7.02 (0.05H, d, J = 12.5 Hz, =CH), 6.56 (0.95H, d, J = 16.0 Hz, =CH), 6.14 (0.05H, d, J = 12.5 Hz, =CH), 4.30 (1.9H, q, J = 7.1 Hz, OCH_2), 4.18 (0.1H, q, J = 7.1 Hz, OCH_2), 1.36 (2.85H, t, J = 7.1 Hz, CH_3), 1.25 (0.15H, t, J = 7.1 Hz, CH_3); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 166.0, 148.4, 141.5, 140.5, 130.1, 128.6,

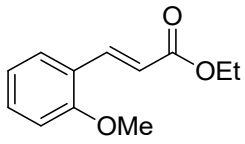
128.3, 124.3, 124.1, 123.3, 123.1, 122.5, 60.9, 60.7, 14.2, 14.0; **MS (ESI)** m/z 222 $[M+H]^+$.

(*E*)-Ethyl 3-(4-methoxyphenyl)acrylate (3f)[15]



The desired product was synthesized following the General Procedure. Reaction time: 1 h; Yield **85%**; (E/Z:80:20); Brown oil; NMR data in accordance with reported literature;[15] **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.71 (0.4H, d, J = 8.8 Hz, ArH), 7.66 (0.8H, d, J = 16.0 Hz, =CH), 7.50 (1.6H, d, J = 8.8 Hz, ArH), 6.92 (2H, d, J = 8.8 Hz, ArH), 6.86 (0.2H, d, J = 12.7 Hz, =CH), 6.33 (0.8H, d, J = 16.0 Hz, =CH), 5.85 (0.2H, d, J = 12.7 Hz, =CH), 4.28 (1.6H, q, J = 7.1 Hz, OCH_2), 4.21 (0.4H, q, J = 7.1 Hz, OCH_2), 3.86 (2.4 H, s, OCH_3), 3.85 (0.6H, s, OCH_3), 1.35 (2.4H, t, J = 7.1 Hz, CH_3), 1.30 (0.6H, t, J = 7.1 Hz, CH_3); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 167.3, 166.5, 161.3, 160.4, 144.2, 143.1, 132.1, 130.9, 129.7, 128.8, 127.2, 117.3, 115.8, 114.3, 60.3, 60.1, 55.3, 55.3, 14.3, 14.2; **MS (ESI)** m/z 207 $[M+H]^+$.

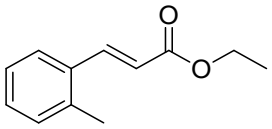
(*E*)-Ethyl 3-(2-methoxyphenyl)acrylate (3g)[13]



The desired product was synthesized following the General Procedure. Reaction time: 1 h; Yield **70%**; (E/Z 90:10); Yellow oil; NMR data in accordance with reported literature.[13] **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 8.01 (0.9H, d, J = 16.2 Hz, =CH), 7.56 (0.1H, dd, J = 7.6 and 1.7 Hz, ArH), 7.53 (0.9H, dd, J = 7.6 and 1,7 Hz, ArH), 7.40-7.34 (1H, m, ArH), 7.18 (0.1H, d, J = 12.5 Hz, =CH), 7.01-6.88 (2H, m, ArH), 6.55 (0.9H, d, J = 16.2 Hz, =CH), 5.99 (0.1H, d, J = 12.5 Hz, =CH), 4.29 (1.8H, q, J = 7.1 Hz, OCH_2), 4.16 (0.2H, q, J = 7.1 Hz, OCH_2), 3.91 (2.7H, s, OCH_3), 3.86 (0.3H, s, OCH_3), 1.36 (2.7H, t, J = 7.1 Hz, CH_3), 1.22 (0.3H, t, J = 7.1 Hz, CH_3); **^{13}C NMR** (100

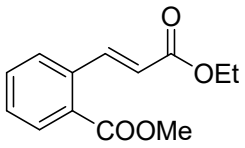
MHz, $CDCl_3$) *E*-isomer *δ:* 167.5, 158.3, 140.0, 131.4, 128.9, 123.5, 120.7, 118.8, 111.1, 60.3, 55.4, 14.3; **MS (ESI)** m/z 207 $[M+H]^+$.

(*E*)-Ethyl 3-(o-tolyl)acrylate (3h)[13]



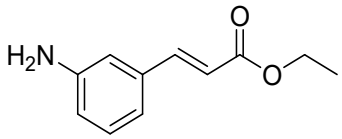
The desired product was synthesized following the General Procedure. Reaction time: 1 h; Yield **69%**; Colorless oil; NMR data in accordance with reported literature;[13] **^{1}H NMR** (400 MHz, $CDCl_3$) *δ:* 8.00 (1H, d, *J* = 16.0 Hz, =CH), 7.57 (1H, d, *J* = 7.3 Hz, ArH), 7.33-7.19 (3H, m, ArH), 6.38 (1H, d, *J* = 16.0 Hz, =CH), 4.30 (2H, q, *J* = 7.1 Hz, OCH_2), 2.47 (3H, s, CH_3), 1.37 (3H, t, *J* = 7.1 Hz, CH_3); **^{13}C NMR** (100 MHz, $CDCl_3$) *δ:*167.1, 142.3, 137.6, 133.4, 130.8, 129.9, 126.4, 126.3, 119.3, 60.5, 19.8, 14.3; **MS (ESI)** m/z 191 $[M+H]^+$.

(*E*)-Methyl 2-(3-ethoxy-3-oxoprop-1-en-1-yl)benzoate (3i)[16]



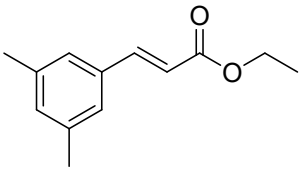
The desired product was synthesized following the General Procedure. Reaction time: 1 h; Yield **79%**; Yellow oil; NMR data in accordance with reported literature;[16] **^{1}H NMR** (400 MHz, $CDCl_3$) *δ*: 8.44 (1H, d, *J* = 15.9 Hz, =CH), 7.96 (1H, dd, *J* = 7.7 and 1.1 Hz, ArH), 7.60 (1H, dd, *J* = 7.7 and 1.1 Hz, ArH), 7.54 (1H, td, *J* = 7.7 and 1.1 Hz, ArH), 7.43 (1H, td, *J* = 7.7 and 1.1 Hz, ArH), 6.31 (1H, d, *J* = 15.9 Hz, =CH), 4.28 (2H, q, *J* = 7.1 Hz, OCH_2), 3.93 (3H, s, OCH_3), 1.34 (3H, t, *J* = 7.1 Hz, CH_3); **^{13}C NMR** (100 MHz, $CDCl_3$) *δ:* 167.1, 166.5, 143.6, 136.3, 132.3, 130.7, 129.7, 129.2, 127.8, 121.1, 60.5, 52.3, 14.2; **MS (ESI)** m/z 235 $[M+H]^+$.

(*E*)-Ethyl 3-(3-aminophenyl)acrylate (3j)[17]



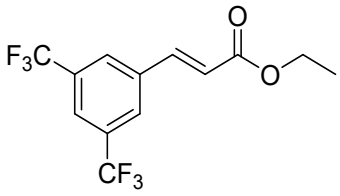
The desired product was synthesized following the General Procedure. Reaction time: 1 h; Yield **75%**; Colorless oil; NMR data in accordance with reported literature;[17] **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.59 (1H, d, J = 16.0 Hz, =CH), 7.18 (1H, t, J = 7.8 Hz, ArH), 6.97 (1H, d, J = 7.8 Hz, ArH), 6.88 (1H, s, ArH), 6.76 (1H, d, J = 7.8 Hz, ArH), 6.38 (1H, d, J = 16.0 Hz, =CH), 4.25 (2H, q, J = 7.1 Hz, OCH_2), 1.33 (3H, t, J = 7.1 Hz, CH_3); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 167.0, 145.7, 144.7, 135.6, 129.8, 119.3, 118.2, 117.5, 114.6, 60.5, 14.3; **MS (ESI)** m/z 192 $[M+H]^+$.

(*E*)-Ethyl 3-(3,5-dimethylphenyl)acrylate (3k)[13]



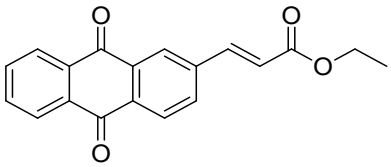
The desired product was synthesized following the General Procedure. Reaction time: 1 h; Yield **68%**; Colorless oil; NMR data in accordance with reported literature;[13] **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.65 (1H, d, J = 16.0 Hz, =CH), 7.17 (2H, s, ArH), 7.04 (1H, s, ArH), 6.43 (1H, d, J = 16.0 Hz, =CH), 4.28 (2H, q, J = 7.1 Hz, OCH_2), 2.35 (6H, s, 2 x CH_3), 1.36 (3H, t, J = 7.1 Hz, CH_3); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 167.1, 144.9, 138.4, 134.4, 132.0, 125.9, 117.8, 60.4, 21.1, 14.3; **MS (ESI)** m/z 205 $[M+H]^+$.

(*E*)-Ethyl 3-(3,5-bis(trifluoromethyl)phenyl)acrylate (3l)



The desired product was synthesized following the General Procedure. Reaction time: 1 h; Yield **74%**; White solid; m.p.: 74-76 °C; **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.96 (2H, s, ArH), 7.89 (1H, s, ArH), 7.74 (1H, d, J = 16.1 Hz, =CH), 6.60 (1H, d, J = 16.1 Hz, =CH), 4.32 (2H, q, J = 7.1 Hz, OCH_2), 1.37 (3H, t, J = 7.1 Hz, CH_3); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 165.8, 140.9, 136.6, 132.5 (q, J = 33.7 Hz), 127.6 (q, J = 2.7 Hz), 123.3 (sept, J = 3.8 Hz), 123.0 (q, J = 272.8 Hz), 122.3, 61.0, 14.2; **^{19}F NMR** (376 MHz, $CDCl_3$) δ: -63.2; **HRMS** exact mass calculated for $[M+Na]^+$ ($C_{13}H_{10}F_6O_2Na^+$) requires *m/z* 335.0477, found *m/z* 335.0475.

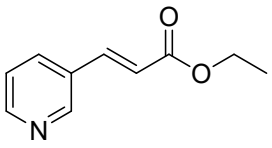
(*E*)-Ethyl 3-(9,10-dioxo-9,10-dihydroanthracen-2-yl)acrylate (3m)



The desired product was synthesized following the General Procedure. Reaction time: 3 h; Yield **50%**; (E/Z: 90:10); Pale yellow solid; m.p.: 146-152 °C; **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 8.43 (0.9H, d, J = 1.8 Hz, ArH), 8.37 (0.1H, m, ArH), 8.35-8.28 (3H, m, ArH), 7.98-7.95 (0.1H, m, ArH), 7.89 (0.9H, dd, J = 8.2 and 1.6 Hz, ArH), 7.86-7.81 (2H, m, ArH), 7.78 (0.9, d, J = 16.0 Hz, =CH), 7.09 (0.1H, d, J = 12.5 Hz, =CH), 6.67 (0.9H, d, J = 16.0 Hz, =CH), 6.17 (0.1H, d, J = 12.5 Hz, =CH), 4.31 (1.8H, q, J = 7.1 Hz, OCH_2), 4.22 (0.2H, q, J = 7.1 Hz, OCH_2), 1.38 (2.7H, t, J = 7.1 Hz, CH_3), 1.26 (0.3H, t, J = 7.1 Hz, CH_3); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 182.6, 182.4, 166.1, 165.4, 142.1, 140.9, 140.8, 140.1, 134.6, 134.3, 134.3, 134.2, 134.1, 133.9, 133.9, 133.5, 133.4, 133.1, 132.9, 128.0, 127.3, 127.3, 126.5, 122.3, 60.9, 60.8, 14.3, 14.0; **HRMS**

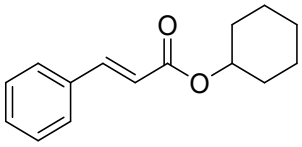
exact mass calculated for $[M+H]^+$ ($C_9H_{15}O_4^+$) requires *m/z* 307.0965, found *m/z* 307.0964.

(*E*)-Ethyl 3-(pyridin-3-yl)acrylate (3n)[18]



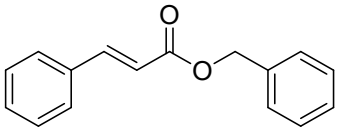
The desired product was synthesized following the General Procedure. Reaction time: 2 h; Yield **72%**; Brown oil; NMR data in accordance with reported literature;[27] **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 8.72 (1H, s, ArH), 8.57 (1H, d, J = 4.3 Hz, ArH), 7.82 (1H, d, J = 7.4 Hz, ArH), 7.64 (1H, d, J = 16.1 Hz, =CH), 7.33-7.29 (1H, m, ArH), 6.48 (1H, d, J = 16.1 Hz, =CH), 4.25 (2H, q, J = 7.1 Hz, OCH_2), 1.32 (3H, t, J = 7.1 Hz, CH_3); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 166.3, 150.8, 149.6, 140.8, 134.3, 130.3, 123.8, 120.5, 60.8, 14.3; **MS (ESI)** m/z 178 $[M+H]^+$.

Cyclohexyl cinnamate (3o)[19]



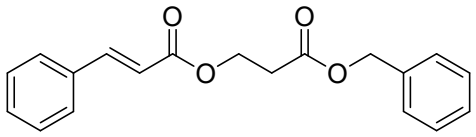
The desired product was synthesized following the General Procedure. Reaction time: 2 h; Yield **55%**; Yellowish oil; NMR data in accordance with reported literature;[18] **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.71 (1H, d, J = 16.0 Hz, =CH), 7.57-7.50 (2H, m, ArH), 7.43-7.35 (3H, m, ArH), 6.45 (1H, d, J = 16.0 Hz, =CH), 4.92 (1H, tt, J = 8.9 and 3.9 Hz, OCH), 2.00-1.89 (2H, m, 2 x C*H*H), 1.85-1.74 (2H, m, 2 x C*H*H), 1.65-1.25 (6H, m, 6 x C*H*H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ*:* 166.3, 144.1, 134.5, 130.0, 128.7, 127.9, 118.8, 72.6, 31.6, 25.3, 23.7; **MS (ESI)** m/z 231 $[M+H]^+$.

Benzyl cinnamate (3p)[19]



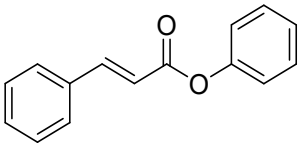
The desired product was synthesized following the General Procedure. Reaction time: 1.5 h; Yield **68%;** White crystals; m.p.: 37-39 ^{o}C; NMR data in accordance with reported literature;[16] **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.82 (1H, d, J = 16.0 Hz, =CH), 7.59-7.54 (2H, m, ArH), 7.51-7.39 (8H, m, ArH), 6.57 (1H, d, J = 16.0 Hz, =CH), 5.33 (2H, s, OCH_2); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 166.5, 145.0, 136.0, 134.2, 130.2, 128.7 128.4, 128.1, 128.1, 127.9, 117.7, 66.2; **MS (ESI)** m/z 239 $[M+H]^+$.

2-(Acryloyloxy)Ethyl cinnamate (3q)



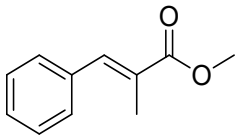
The desired product was synthesized following the General Procedure. Reaction time: 2 h; Yield **74%;** Colorless oil; **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.70 (1H, d, J = 16.0 Hz, =CH), 7.57-7.49 (2H, m, ArH), 7.44-7.30 (8H, m, ArH), 6.43 (1H, d, J = 16.0 Hz, =CH), 5.21 (2H, s, OCH_2Ph), 4.54 (2H, t, J = 6.3 Hz, OCH_2), 2.81 (2H, t, J = 6.3 Hz, CH_2CO); **^{13}C NMR**: (100 MHz, $CDCl_3$) δ: 170.5, 166.5, 145.1, 135.6, 134.2, 130.3, 128.8, 128.5, 128.2, 128.2, 128.0, 117.6, 66.5, 59.8, 34.0; **HRMS** exact mass calculated for $[M+Na]^+$ ($C_{19}H_{18}O_4Na^+$) requires *m/z* 333.1097, found *m/z* 333.1095.

Phenyl cinnamate (3r)[13]



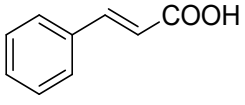
The desired product was synthesized following the General Procedure. Reaction time: 1.5 h; Yield **76%**; White crystals; m.p.: 76-78 °C; NMR data in accordance with reported literature;[13] **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.93 (1H, d, J = 16.0 Hz, =CH), 7.67-7.59 (2H, m, ArH), 7.50-7.42 (5H, m, ArH), 7.34-7.27 (1H, m, ArH), 7.26-7.20 (2H, m, ArH), 6.69 (1H, d, J = 16.0 Hz, =CH); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 165.3, 150.8, 146.5, 134.1, 130.6, 129.4, 128.9, 128.2, 125.7, 121.6, 117.3; **MS (ESI)** m/z 225 $[M+H]^+$.

(*E*)-Methyl 2-methyl-3-phenylacrylate (3s)[12]



The desired product was synthesized following the General Procedure. Reaction time: 2.5 h; Yield **60%**; Colorless oil; NMR data in accordance with reported literature;[12] **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.69 (1H, s, =CH), 7.42-7.37 (4H, m, ArH), 7.35-7.31 (1H, m, ArH), 3.82 (3H, s, OCH_3), 2.13 (3H, s, CH_3); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 169.2, 139.0, 135.9, 129.7, 128.4, 128.4, 52.1, 14.1; **MS (ESI)** m/z 177 $[M+H]^+$.

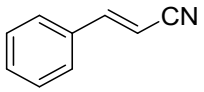
Cinnamic acid (3t)[20]



The desired product was synthesized following the General Procedure. Reaction time: 2 h; Yield **62%**; White solid; m.p.: 131-133 ^{o}C; NMR data in accordance with reported literature.[19] **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.82 (1H, d, J = 16.0 Hz, =CH), 7.61-7.54

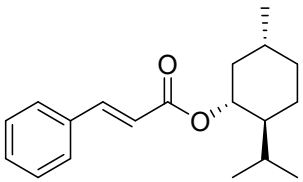
(2H, m, ArH), 7.46-7.40 (3H, m, ArH), 6.49 (1H, d, J = 16.0 Hz, =CH); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 172.0, 147.1, 134.1, 130.7, 129.0, 128.4, 117.2; **MS (ESI)** m/z 148 $[M]^+$.

Cinnamonitrile (3u)[21]



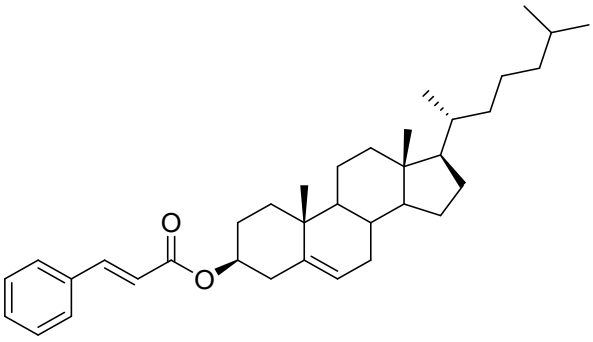
The desired product was synthesized following the General Procedure. Reaction time: 2 h; Yield **76%**; (E/Z: 85/15); Colorless oil; NMR data in accordance with reported literature;[20] **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.86-7.81 (0.3H, m, ArH), 7.50-7.38 (5.55H, m, ArH and =CH), 7.15 (0.15H, d, J = 12.1 Hz, =CH), 5.90 (0.85H, d, J = 16.7 Hz, =CH), 5.47 (0.15H, d, J = 12.1 Hz, =CH); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 150.5, 148.6, 133.5, 131.1, 130.9, 129.1, 128.9, 128.9, 127.3, 118.1, 117.3, 96.3, 95.0; **MS (ESI)** m/z 130 $[M+H]^+$.

(1*R*,2*S*,5*R*)-2-Isopropyl-5-methylcyclohexyl cinnamate (3v)[22]



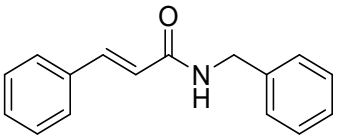
The desired product was synthesized following the General Procedure. Reaction time: 1 h; Yield **75%**; Colorless oil; $[\alpha]_D$ -81.0 (c 0.26 in $CHCl_3$); NMR data in accordance with reported literature;[21] **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.70 (1H, d, J = 16.0 Hz, =CH), 7.59-7.53 (2H, m, ArH), 7.43-7.37 (3H, m, ArH), 6.46 (1H, d, J = 16.0 Hz, =CH), 4.85 (1H, td, J = 10.8 and 4.4 Hz, OCH), 2.11 (1H, d, J = 12.1 Hz, CH), 1.96 (1H, dtd, J = 14.0, 7.0 and 2.6 Hz, CH), 1.79-1.69 (2H, m, 2 x C*H*H), 1.63-1.43 (2H, m, 2 x C*H*H), 1.18-1.02 (2H, m, 2 x C*H*H), 0.98-0.90 (7H, m, 2 x CH_3 and CH), 0.83 (3H, d, J = 7.0 Hz, CH_3); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 166.6, 144.3, 134.6, 130.1, 128.8, 128.0, 118.8, 74.3, 47.2, 41.0, 34.3, 31.4, 26.4, 23.6, 22.0, 20.7, 16.4; **MS (ESI)** m/z 287 $[M+H]^+$.

Cholesteryl Cinnamate (3w)[22]



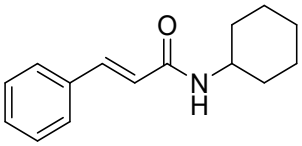
The desired product was synthesized following the General Procedure. Reaction time: 18 h; Yield **48%**; Yellowish solid; m.p.: 150-152 °C; $[\alpha]_D$ -3.0 (*c* 1.02 in $CHCl_3$); NMR data in accordance with reported literature;[21] **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.70 (1H, d, *J* = 16.0 Hz, =CH), 7.58-7.50 (2H, m, ArH), 7.43-7.36 (3H, m, ArH), 6.45 (1H, d, *J* = 16.0 Hz, =CH), 5.43 (1H, d, *J* = 3.9 Hz, =CH), 4.84-4.72 (1H, m, OCH), 2.44 (2H, d, *J* = 7.5 Hz, 2 x C*H*H), 2.09-0.98 (29H, m, 20 x C*H*H, 6 x CH and CH_3), 0.95 (3H, d, *J* = 6.5 Hz, CH_3), 0.90 (6H, d, *J* = 6.5 Hz, 2 x CH_3), 0.71 (3H, s, CH_3); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 166.3, 144.4, 139.7, 134.5, 130.1, 128.8, 128.0, 122.7, 118.7, 74.1, 56.7, 56.1, 50.0, 42.3, 39.7, 39.5, 38.2, 37.0, 36.6, 36.2, 35.8, 31.9, 31.9, 28.2, 28.0, 27.9, 24.3, 23.8, 22.8, 22.5, 21.0, 19.3, 18.7, 11.8; **MS (ESI)** m/z 517 $[M+H]^+$.

***N*-Benzylcinnamamide (3x)**[23]



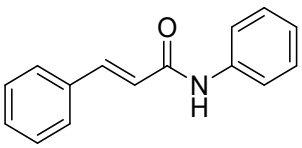
The desired product was synthesized following the General Procedure. Reaction time: 1.5 h; Yield **68%**; White solid; m.p.: 107-110 °C; NMR data in accordance with reported literature.[22] **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.69 (1H, d, *J* = 15.6 Hz, =CH), 7.53-7.45 (2H, m, ArH), 7.39-7.24 (8H, m, ArH), 6.48 (1H, d, *J* = 15.6 Hz, =CH), 6.36-6.24 (1H, br s, NH), 4.56 (2H, d, *J* = 5.5 Hz, NCH_2); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 165.8, 141.3, 138.2, 134.7, 129.7, 128.8, 128.7, 127.8, 127.8, 127.5, 120.5, 43.8; **MS (ESI)** m/z 238 $[M+H]^+$.

N-Cyclohexylcinnamamide (3y)[24]



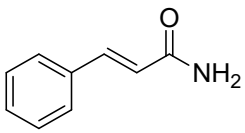
The desired product was synthesized following the General Procedure. Reaction time: 1 h; Yield **69%**; White solid; m.p.: 107-108 °C. NMR data in accordance with reported literature;[23] **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.63 (1H, d, J = 15.6 Hz, =CH), 7.55-7.48 (2H, m, ArH), 7.41-7.34 (3H, m, ArH), 6.39 (1H, d, J = 15.6 Hz, =CH), 5.54 (1H, br s, NH), 3.99-3.89 (1H, m, NCH), 2.07-1.98 (2H, m, 2 x C*H*H), 1.80-1.63 (3H, m, 3 x C*H*H), 1.49-1.38 (2H, m, 2 x C*H*H), 1.29-1.15 (3H, m, 3 x C*H*H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 164.9, 140.7, 135.0, 129.5, 128.8, 127.7, 121.1, 48.4, 33.2, 25.6, 24.9; **MS (ESI)** m/z 252 $[M+Na]^+$.

N-Phenylcinnamamide (3z)[25]



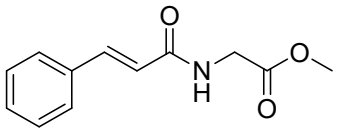
The desired product was synthesized following the General Procedure. Reaction time: 1.5 h; Yield **78%**; White solid; m.p.: 154-155 °C. NMR data in accordance with reported literature;[24] **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 8.47 (1H, br s, NH), 7.77 (1H, d, J = 15.6 Hz, =CH), 7.73-7.66 (2H, m, ArH), 7.46-7.40 (2H, m, ArH), 7.38-7.26 (5H, m, ArH), 7.13 (1H, t, J = 7.3 Hz, ArH), 6.73 (1H, d, J = 15.6 Hz, =CH); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 164.6, 142.2, 138.1, 134.5, 129.8, 129.0, 128.7, 127.9, 124.4, 121.1, 120.3; **MS (ESI)** m/z 224 $[M+H]^+$.

Cinnamamide (3aa)[26]



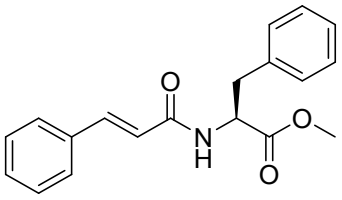
The desired product was synthesized following the General Procedure. Reaction time: 2 h; Yield **58%**; White solid; m.p.: 148-150 °C; NMR data in accordance with reported literature;[25] **^{1}H NMR** (400 MHz, DMSO-*d6*) δ: 7.59-7.55 (3H, m, NH*H* and ArH), 7.46-7.35 (4H, m, ArH and =CH), 7.10 (1H, br s, NH*H*), 6.62 (1H, d, J = 15.9 Hz, =CH); **^{13}C NMR** (100 MHz, DMSO-*d6*) δ: 166.7, 139.2, 134.9, 129.4, 128.9, 127.5, 122.3; **MS (ESI)** m/z 148 $[M+H]^+$.

Methyl 2-cinnamamidoacetate (3ab)[27]



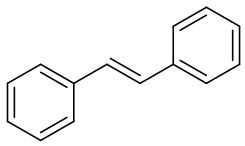
The desired product was synthesized following the General Procedure. Reaction time: 1 h; Yield **75%**; White solid; m.p.: 121-122 °C; NMR data in accordance with reported literature;[26] **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.66 (1H, d, J = 15.7 Hz, =CH), 7.59-7.46 (2H, m, ArH), 7.39-7.32 (3H, m, ArH), 6.55-6.46 (2H, m, =CH and NH), 4.20 (2H, d, J = 5.3 Hz, NCH_2), 3.78 (3H, s, OCH_3); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 170.5, 166.0, 141.8, 134.6, 129.8, 128.7, 127.8, 119.8, 52.4, 41.4; **MS (ESI)** m/z 220 $[M+H]^+$.

(*S*)-Methyl 2-cinnamamido-3-phenylpropanoate (3ac)[28]



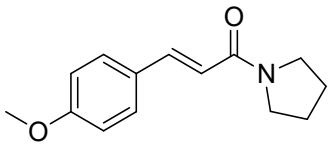
The desired product was synthesized following the General Procedure. Reaction time: 1 h; Yield **72%**; Brown oil; $[\alpha]_D$ +120.0 (*c* 0.51 in $CHCl_3$); NMR data in accordance with reported literature;[27] **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.66 (1H, d, *J* = 15.6 Hz, =CH), 7.54-7.48 (2H, m, ArH), 7.41-7.35 (3H, m, ArH), 7.35-7.25 (3H, m, ArH), 7.18-7.12 (2H, m, ArH), 6.43 (1H, d, *J* = 15.6 Hz, =CH), 6.24-6.16 (1H, br s, NH), 5.08 (1H, dt, *J* = 13.2 Hz and 5.8 Hz, NCH), 3.78 (3H, s, OCH_3), 3.26 (1H, dd, *J* = 13.2 Hz and 5.8 Hz, CH*H*Ph), 3.20 (1H, dd, *J* = 13.2 Hz and 5.8 Hz, C*H*HPh); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 172.0, 165.3, 141.8, 135.8, 134.6, 129.8, 129.3, 128.8, 128.6, 127.9, 127.1, 119.9, 53.3, 52.3, 37.9; **MS (ESI)** m/z 310 $[M+H]^+$.

(*E*)-1,2-diphenylethene (3ad)[13]



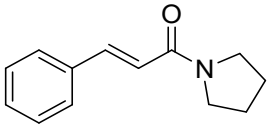
The desired product was synthesized following the General Procedure. Reaction time: 1 h; Yield **83%;** White solid; m.p.: 123-125 ^{o}C; NMR data in accordance with reported literature;[13] **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.60-7.53 (4H, m, ArH), 7.46-7.37 (4H, m, ArH), 7.45-7.28 (2H, m, ArH), 7.16 (2H, s, 2 x =CH); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 137.4, 128.7, 127.7, 126.6; **MS (ESI)** m/z 181 $[M+H]^+$.

(*E*)-3-(4-methoxyphenyl)-1-(pyrrolidin-1-yl)Prop-2-en-1-one (4)[28]



The desired product was synthesized following the General Procedure. Reaction time: 1 h; Yield **83%**; Yellowish oil; NMR data in accordance with reported literature;[28] **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.63 (1H, d, J = 15.4 Hz, =CH), 7.46 (2H, d, J = 8.7 Hz, ArH), 6.86 (2H, d, J = 8.7 Hz, ArH), 6.58 (1H, d, J = 15.4 Hz, =CH), 3.80 (3H, s, OCH_3), 3.57 (4H, m, 2 x NCH_2), 1.97 (2H, quintet, J = 6.7 Hz, 2 x C*H*H), 1.86 (2H, quintet, J = 6.7 Hz, 2 x C*H*H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 165.0, 160.7, 141.2, 129.3, 128.0, 116.5, 114.1, 55.3, 46.5, 45.9, 26.1, 24.3; **MS (ESI)** m/z 232 $[M+H]^+$.

***(E)*-3-Phenyl-1-(pyrrolidin-1-yl)prop-2-en-1-one (5)**[29]



The desired product was synthesized following the General Procedure. Reaction time: 1 h; Yield **91%**; Yellow solid; m.p.; 97-99 ^{o}C; NMR data in accordance with reported literature;[29] **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.70 (1H, d. J = 15.5 Hz, =CH), 7.56-7.51 (2H, m, ArH), 7.38-7.33 (3H, m, ArH), 6.74 (1H, d, J = 15.5 Hz, =CH), 3.60 (4H, m, 2 x NCH_2), 1.99 (2H, quintet, J = 6.7 Hz, 2 x C*H*H), 1.88 (2H, quintet, J = 6.7 Hz, 2 x C*H*H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 164.5, 141.5, 135.2, 129.4, 128.6, 127.7, 118.8, 46.4, 45.9, 26.0, 24.2; **MS (ESI)** m/z 202 $[M+H]^+$.

Procedure for Gram Scale reaction

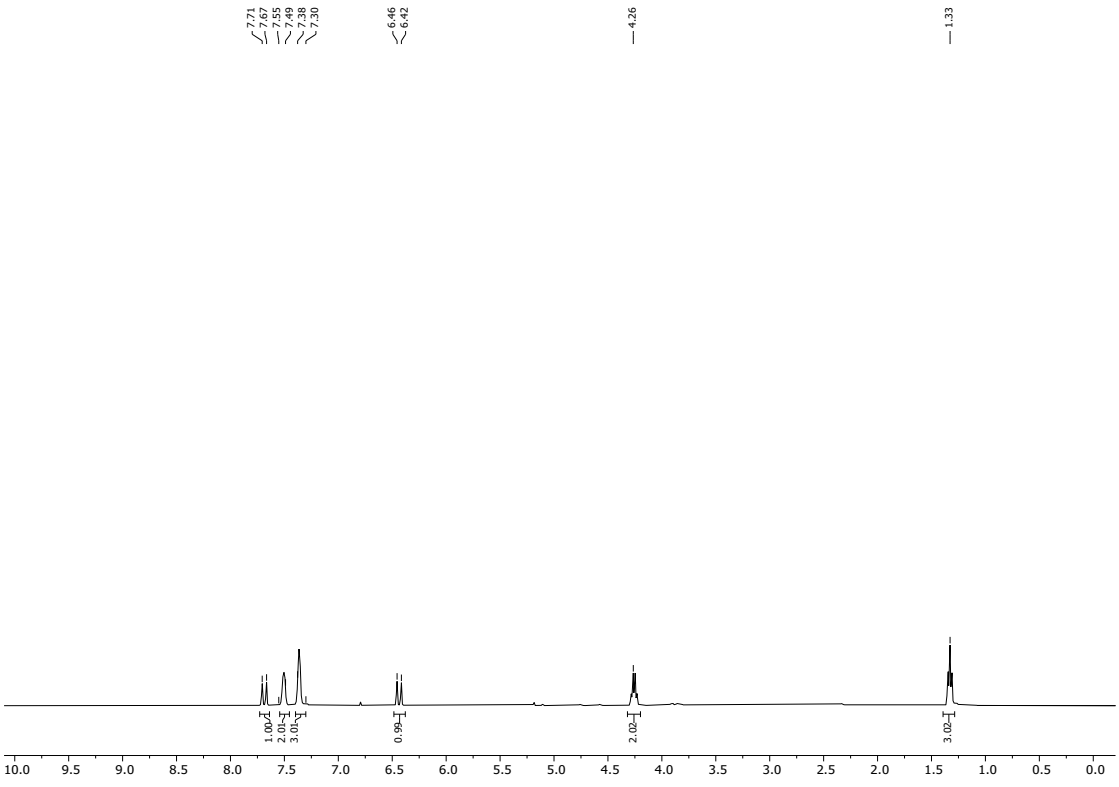
In a screw capped tube, iodobenzene (1.00 g, 4.90 mmol, 1.00 equiv.), ethyl acetate (588 mg, 5.88 mmol, 1.20 equiv.), triethylamine (TEA) (495 mg, 4.90 mmol, 1.00 equiv.), Cyrene (5 mL) and 10 % w/w Pd/C (5.0 mg), were added consecutively. The screw capped tube was sealed with a cap and Teflon and was left stirring at 150 °C for 1 hour. After reaction completion, the reaction mixture was diluted in EtOAc (5 mL) and washed two times with water (2 x 5 mL). The organic layer was concentrated *in vacuo*. No further purification was required.

***E*-factor calculation**

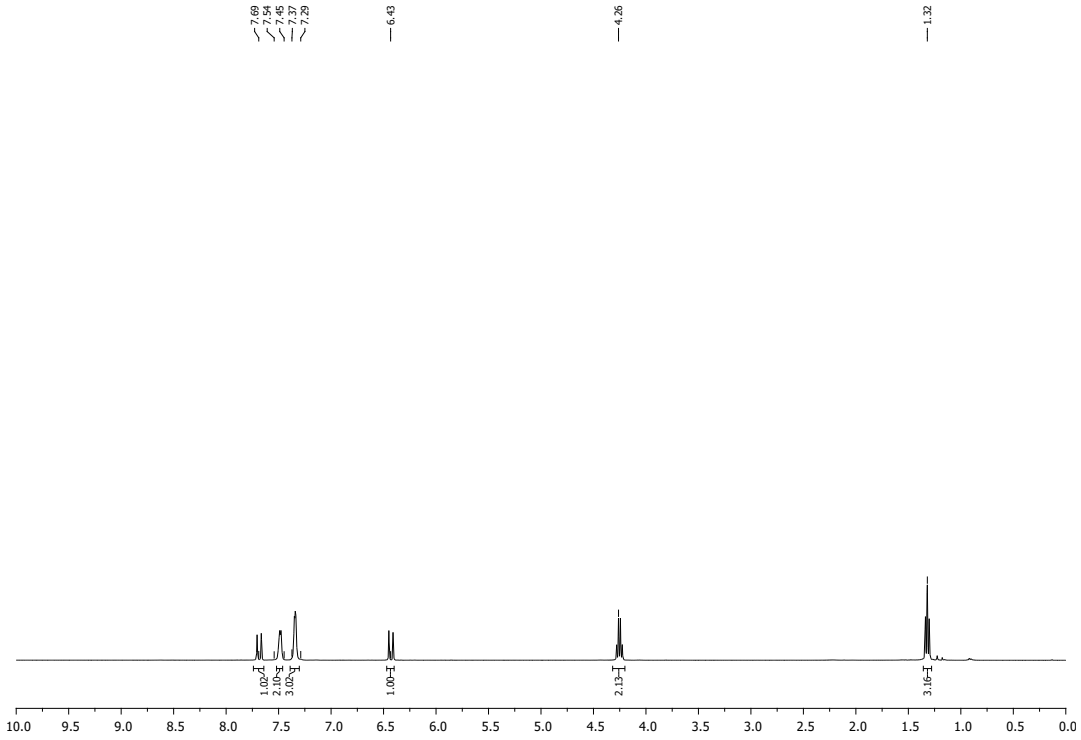
After obtaining the desired product, without proceeding in purification by column chromatography, the *E*-factor of the gram scale reaction was calculated.

[4510 (EtOAc) + 5000 (H_2O) + 1000 (iodobenzene) + 588 (ethyl acrylate) + 495 (triethylamine) + 6250 (Cyrene) + 5 (Pd/C) - 880 (product)]/880 = **19**

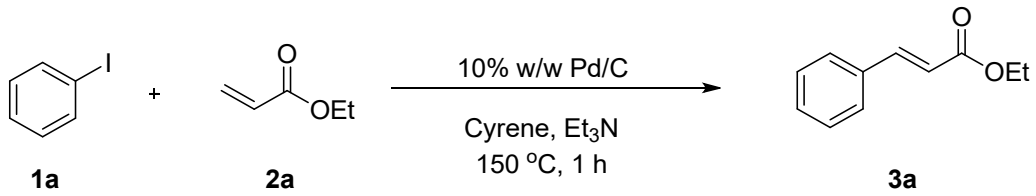
^{1}H NMR spectrum (400MHz, $CDCl_3$) of isolated product without purification by column chromatography



^{1}H NMR spectrum (400 MHz, $CDCl_3$) of isolated product after purification by column chromatography

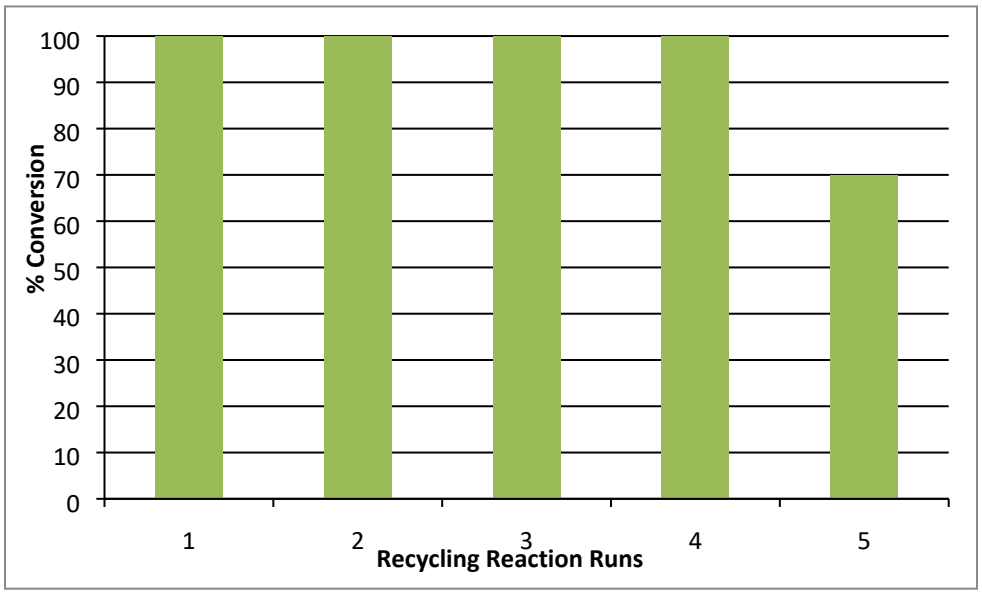


Procedure for Cyrene Recovery and Recycling

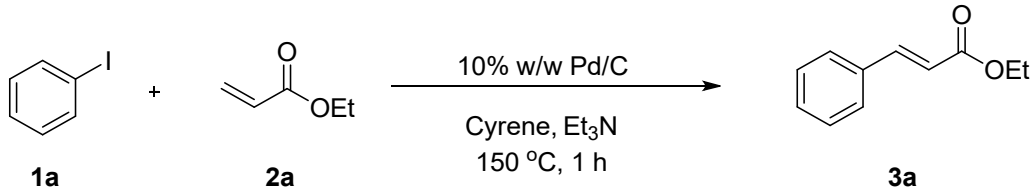


1a **2a** **3a**

In a screw capped tube, iodobenzene (204 mg, 1.00 mmol, 1.00 equiv.), ethyl acrylate (120 mg, 1.20 mmol, 1.20 equiv.), triethylamine (TEA) (0.28 mL, 1.00 mmol, 1.00 equiv.), Cyrene (1 mL) and 10% w/w Pd/C (0.5 mg), were added consecutively. The screw capped tube was sealed with a cap and Teflon and was left under stirring at 150 °C for 1 hour. After reaction completion, the reaction mixture was filtered through a Celite pad. The filtrate was diluted with water (2.5 mL) and EtOAc (2.5 mL) was added. The organic layer was separated and dried over Na_2SO_4. From the aqueous layer, water was removed *in vacuo* or by thermal treatment (100 °C) open air. The amount of recovered Cyrene was 0.7 mL. New substrates were added iodobenzene (143 mg, 0.70 mmol, 1.00 equiv.), ethyl acrylate (85 mg, 0.84 mmol, 1.20 equiv.), triethylamine (TEA) (0.10 mL, 0.70 mmol, 1.00 equiv.) and 10% w/w Pd/C (0.35 mg)]. This procedure was repeated up to four consecutive reaction runs (in analogy), without appreciable loss of reactivity.



Procedure for Catalyst Recovery using Cyrene



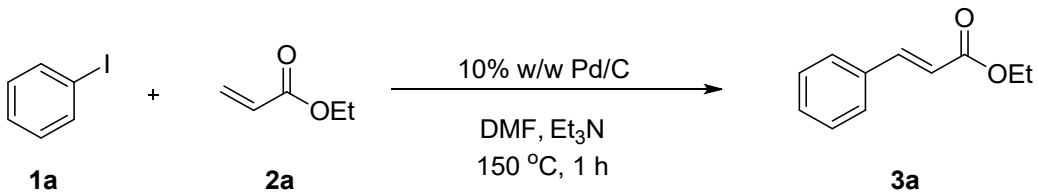
1a **2a** **3a**

In a screw capped tube, iodobenzene (204 mg, 1.00 mmol, 1.00 equiv.), ethyl acrylate (120 mg, 1.20 mmol, 1.20 equiv.), triethylamine (TEA) (0.28 mL, 1.00 mmol, 1.00 equiv.), Cyrene (1 mL) and 10% w/w Pd/C (0.5 mg), were added consecutively. The screw capped tube was sealed with a cap and Teflon and was left under stirring at 150 °C for 1 hour. After reaction completion, the reaction mixture was filtered through a Celite pad. The filtrate was diluted with water (2.5 mL) and EtOAc (2.5 mL) was added. The organic layer was separated and dried over Na_2SO_4. After filtration, the organic solvent was removed *in vacuo* **(Sample 2)**. The desired product was isolated by column chromatography **(Sample 1)**. From the aqueous layer, water was removed *in vacuo*. The amount of recovered Cyrene was 0.7 mL **(Sample 3)**.

Samples 1, 2 and **3** were submitted in IPC-MS test, to check for palladium content.

Sample 1	Sample 2	Sample 3
0.25 ppb	6 ppb	132 ppb

Procedure for Catalyst Recovery using DMF



1a **2a** **3a**

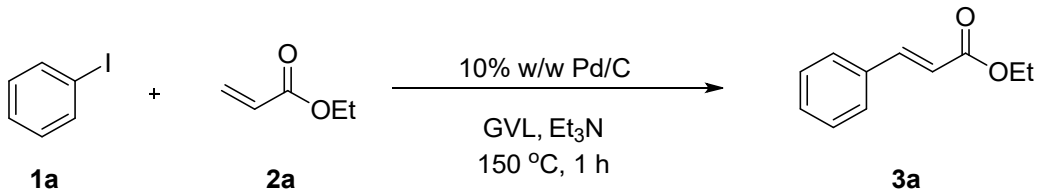
In a screw capped tube, iodobenzene (204 mg, 1.00 mmol, 1.00 equiv.), ethyl acrylate (120 mg, 1.20 mmol, 1.20 equiv.), triethylamine (TEA) (0.28 mL, 1.00 mmol, 1.00 equiv.), DMF (1 mL) and 10% w/w Pd/C (0.5 mg), were added consecutively. The screw capped tube was sealed with a cap and Teflon and was left under stirring at 150 °C for 1 hour. After reaction completion, the reaction mixture was filtered through a Celite pad. The filtrate was diluted with water (2.5 mL) and EtOAc (2.5 mL) was added.

The organic layer was separated and dried over Na_2SO_4. After filtration, the organic solvent was removed *in vacuo* **(Sample DMF 1)**. From the aqueous layer, water was removed *in vacuo*. The amount of recovered DMF was 0.54 mL **(Sample DMF 2)**.

Samples DMF 1 and **DMF 2** were submitted in IPC-MS test, to check for palladium content.

Sample DMF 1	Sample DMF 2
25 ppm	134 ppm

Procedure for Catalyst Recovery using GVL



1a **2a** **3a**

In a screw capped tube, iodobenzene (204 mg, 1.00 mmol, 1.00 equiv.), ethyl acrylate (120 mg, 1.20 mmol, 1.20 equiv.), triethylamine (TEA) (0.28 mL, 1.00 mmol, 1.00 equiv.), GVL (1 mL) and 10% w/w Pd/C (0.5 mg), were added consecutively. The screw capped tube was sealed with a cap and Teflon and was left under stirring at 150 °C for 1 hour. After reaction completion, the reaction mixture was filtered through a Celite pad. The filtrate was diluted with water (2.5 mL) and EtOAc (2.5 mL) was added. The organic layer was separated and dried over Na_2SO_4. After filtration, the organic solvent was removed *in vacuo* **(Sample GVL 1)**. From the aqueous layer, water was removed *in vacuo*. The amount of recovered GVL was 0.4 mL **(Sample GVL 2)**.

Samples GVL 1 and **GVL 2** were submitted in IPC-MS test, to check for palladium content.

Sample GVL 1	Sample GVL 2
1.1 ppm	25 ppm

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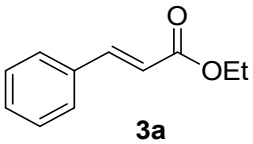
NMR Spectra



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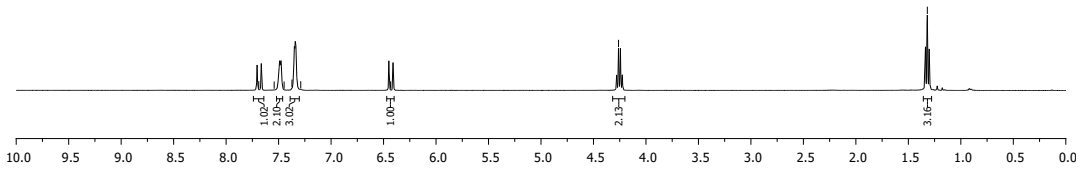

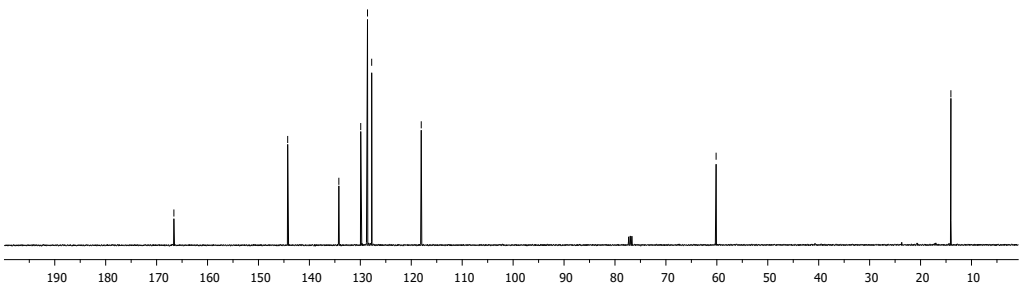

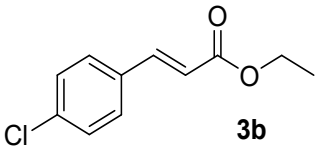
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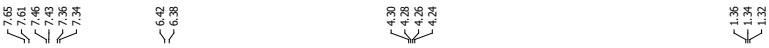
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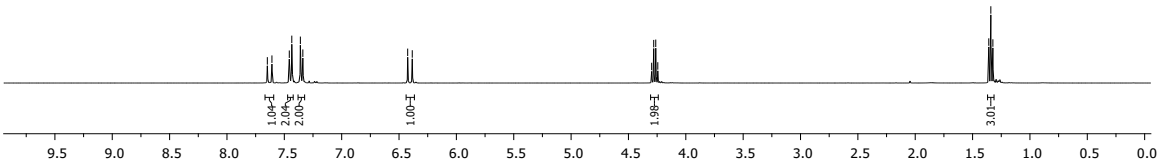
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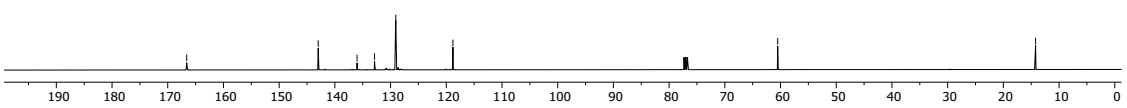
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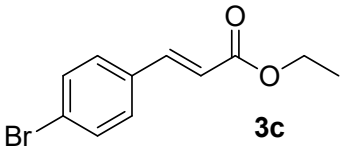
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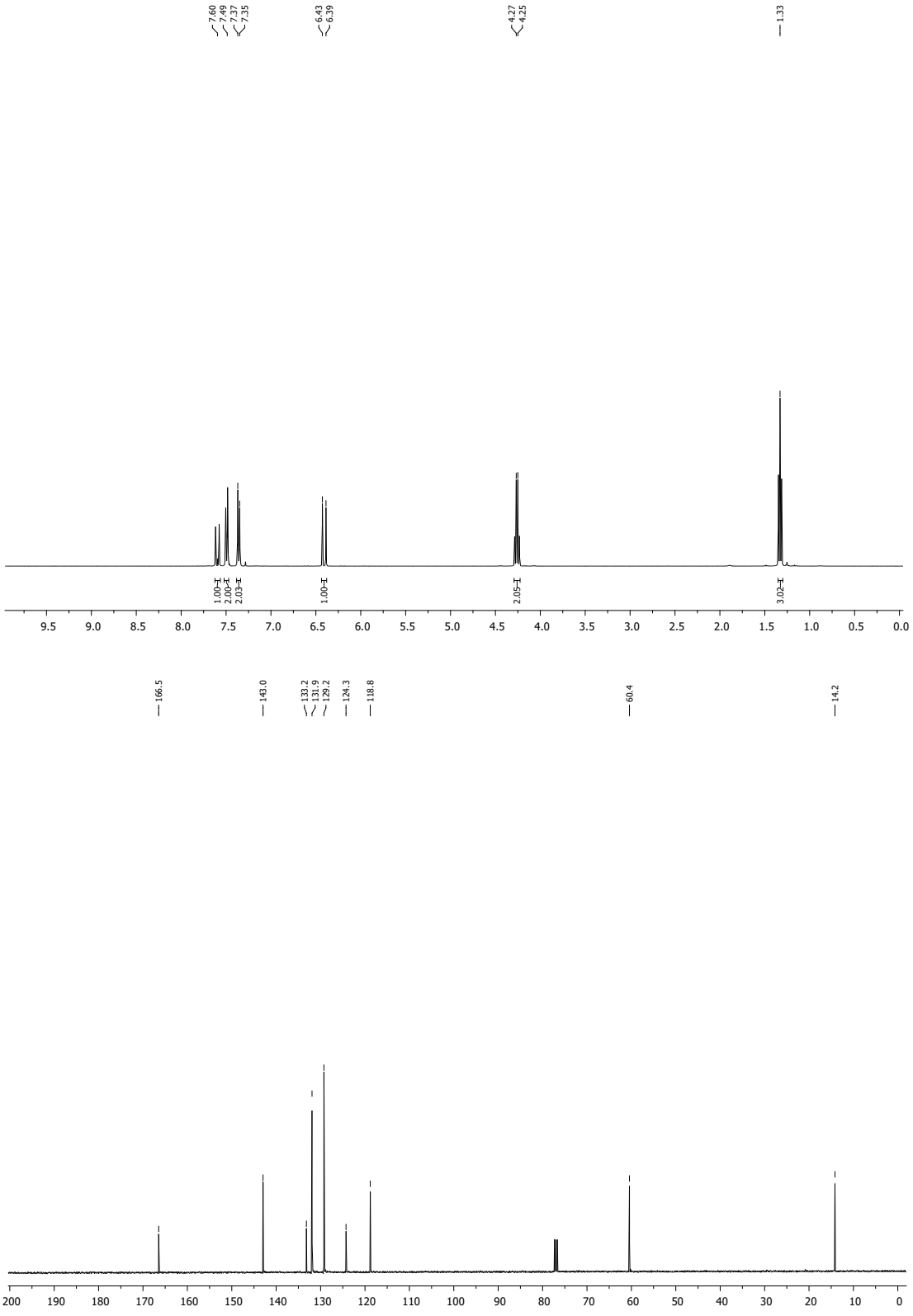
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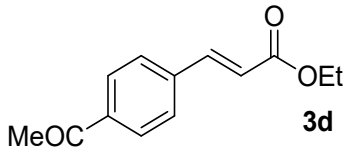
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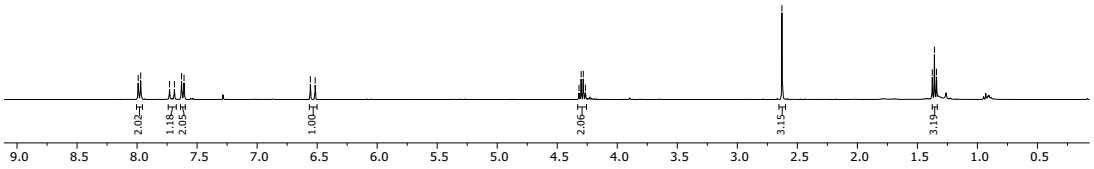
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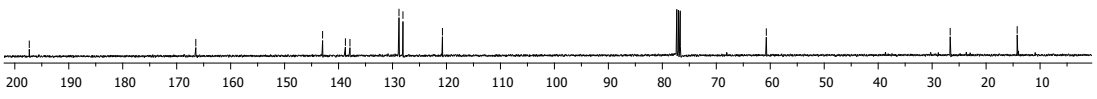
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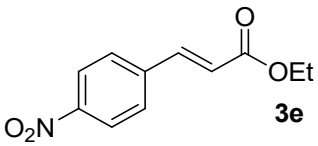
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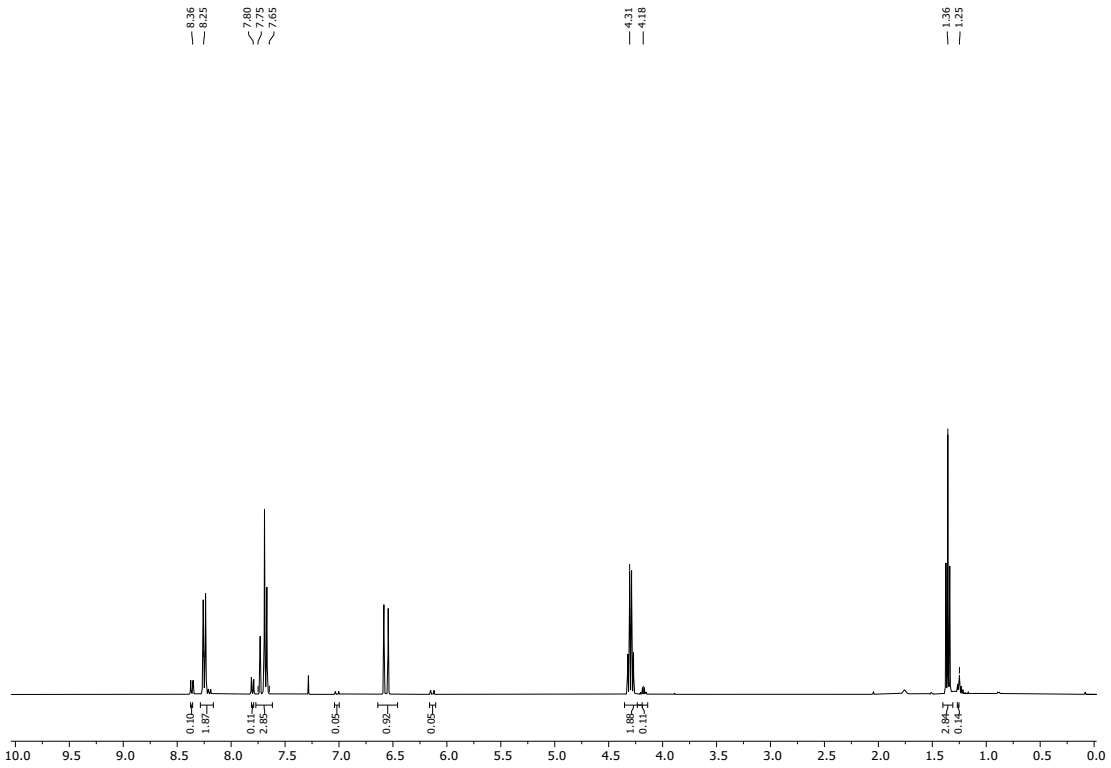
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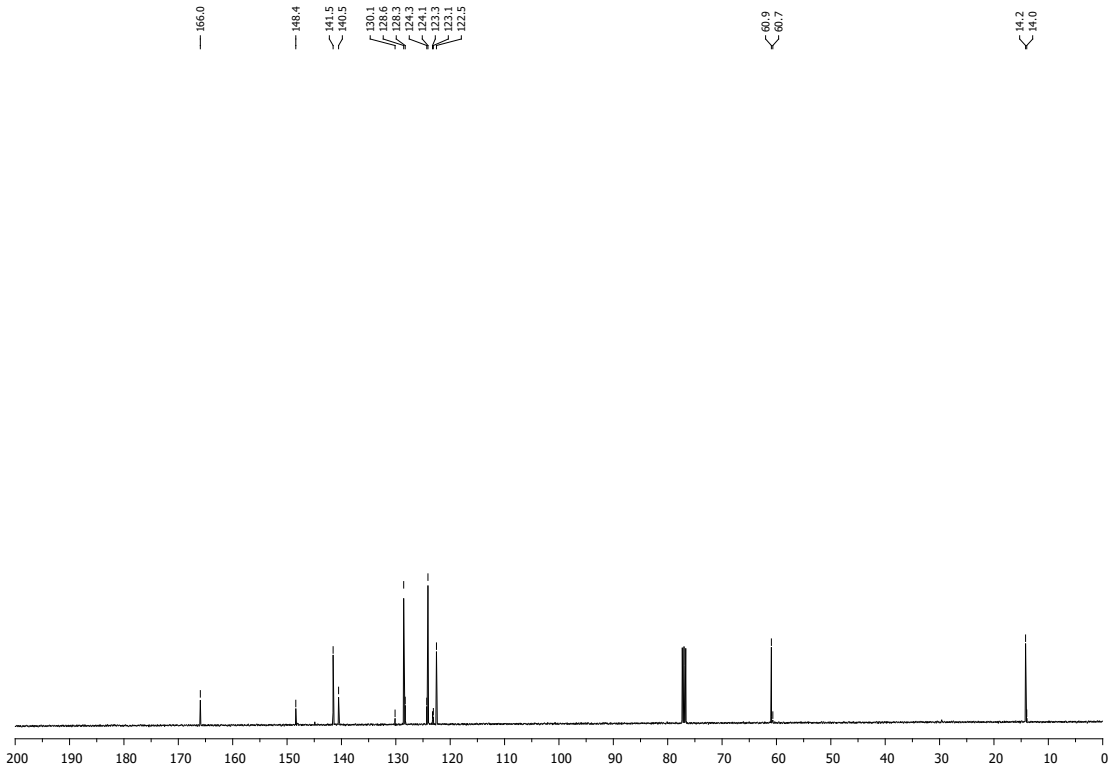
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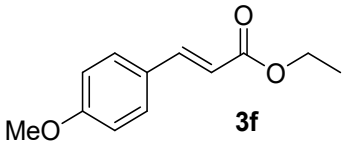
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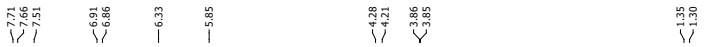
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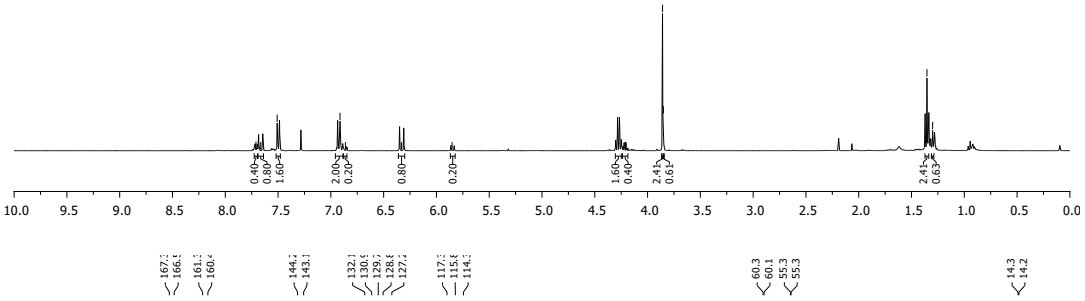
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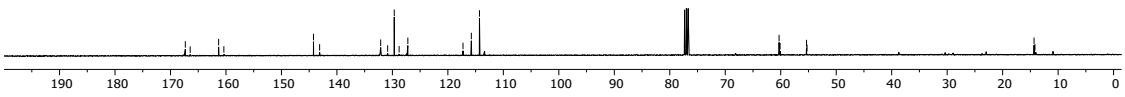
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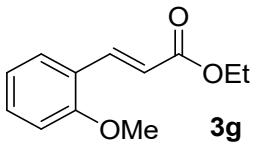
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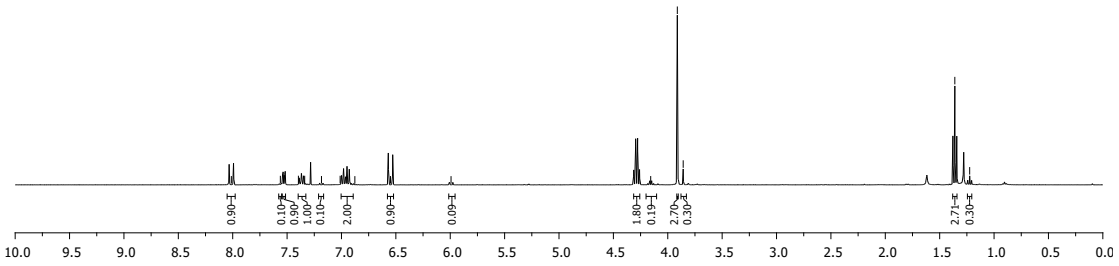
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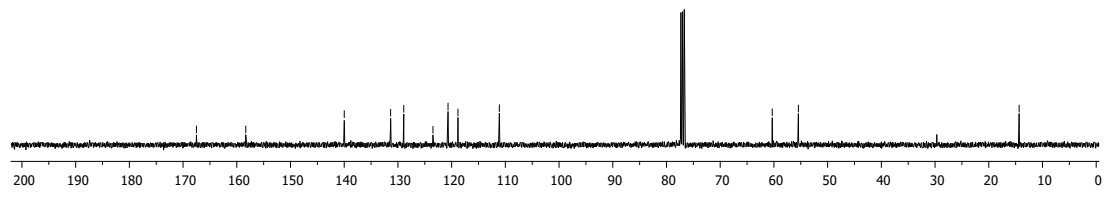
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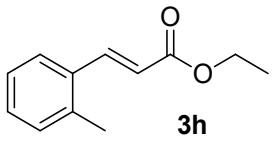

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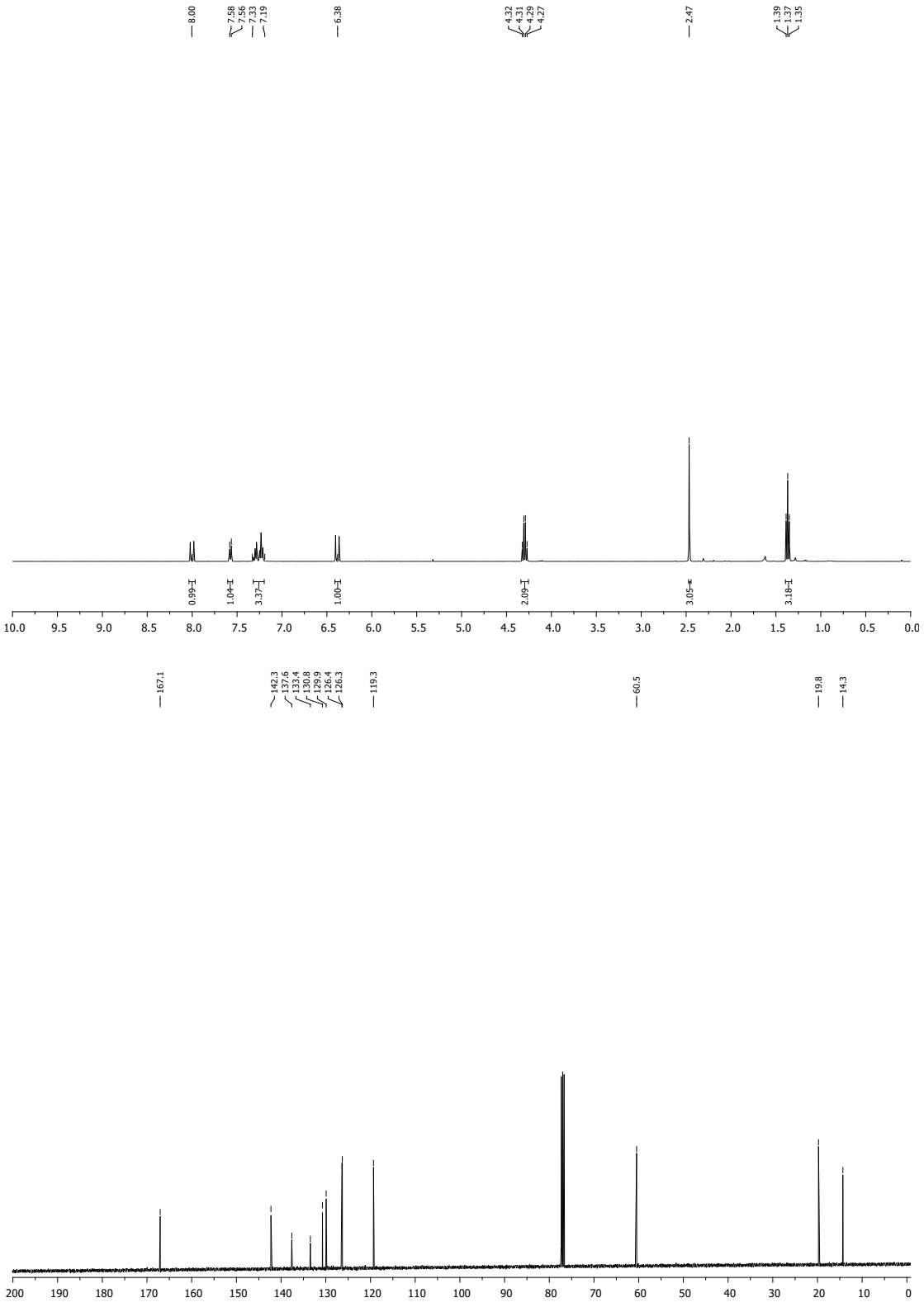
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1.00
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10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
167.1
142.3
137.6
133.4
130.8
129.9
126.4
126.3
119.3
60.5
19.8
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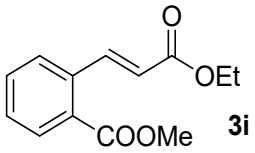
O
OEt
COOMe

3i


8.44
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4.27
4.25
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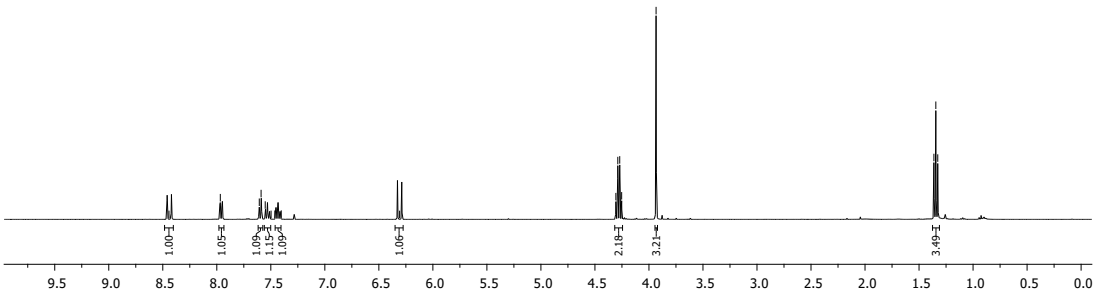
1.34
1.33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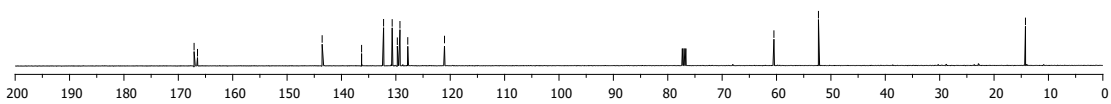
1.05
1.09
1.15
1.09
1.06
2.18
3.21
3.49
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0


167.1
166.5
143.6
136.3
132.3
130.7
129.7
129.2
127.8
121.1
60.5
52.3
14.2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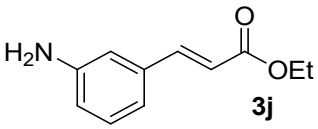
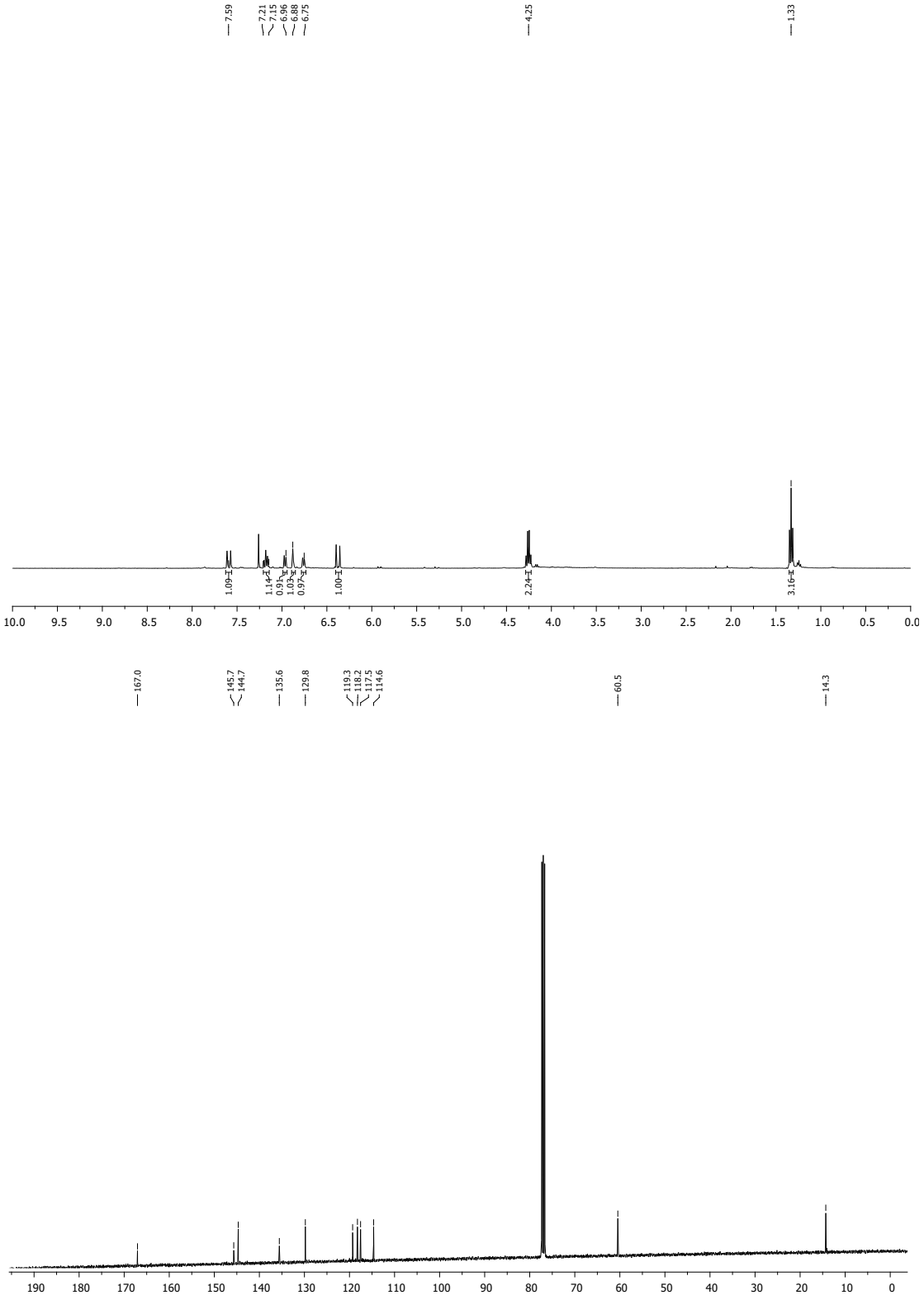

O
H2N
OEt

3j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1.33
1.09
1.14
0.91
1.03
0.97
1.00
2.24
3.16
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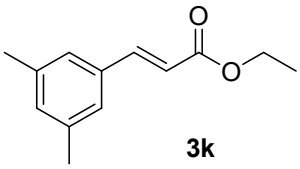
145.7
144.7
135.6
129.8
119.3
118.2
117.5
114.6
60.5
14.3



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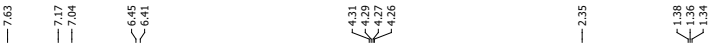
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7.17
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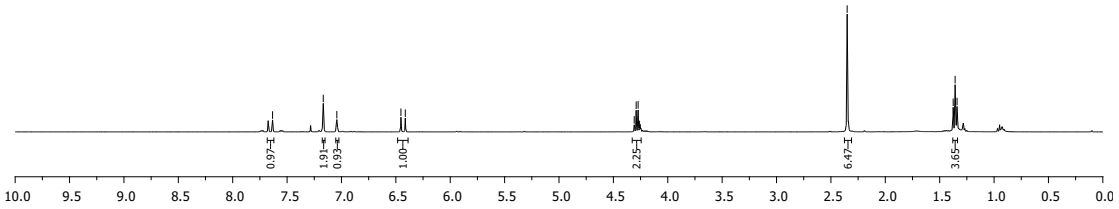
6.45
6.41
4.31
4.29
4.27
4.26
2.35
1.38
1.36
1.34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1.91
0.93
1.00
2.25
6.47
3.65
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0


167.12
144.89
138.36
134.38
131.98
125.91
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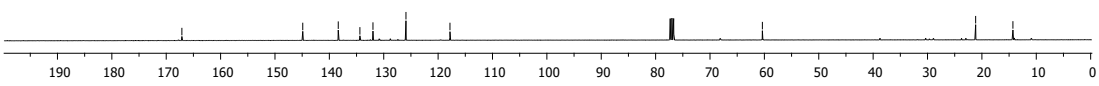
60.37
21.15
14.30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10
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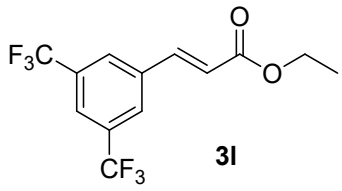
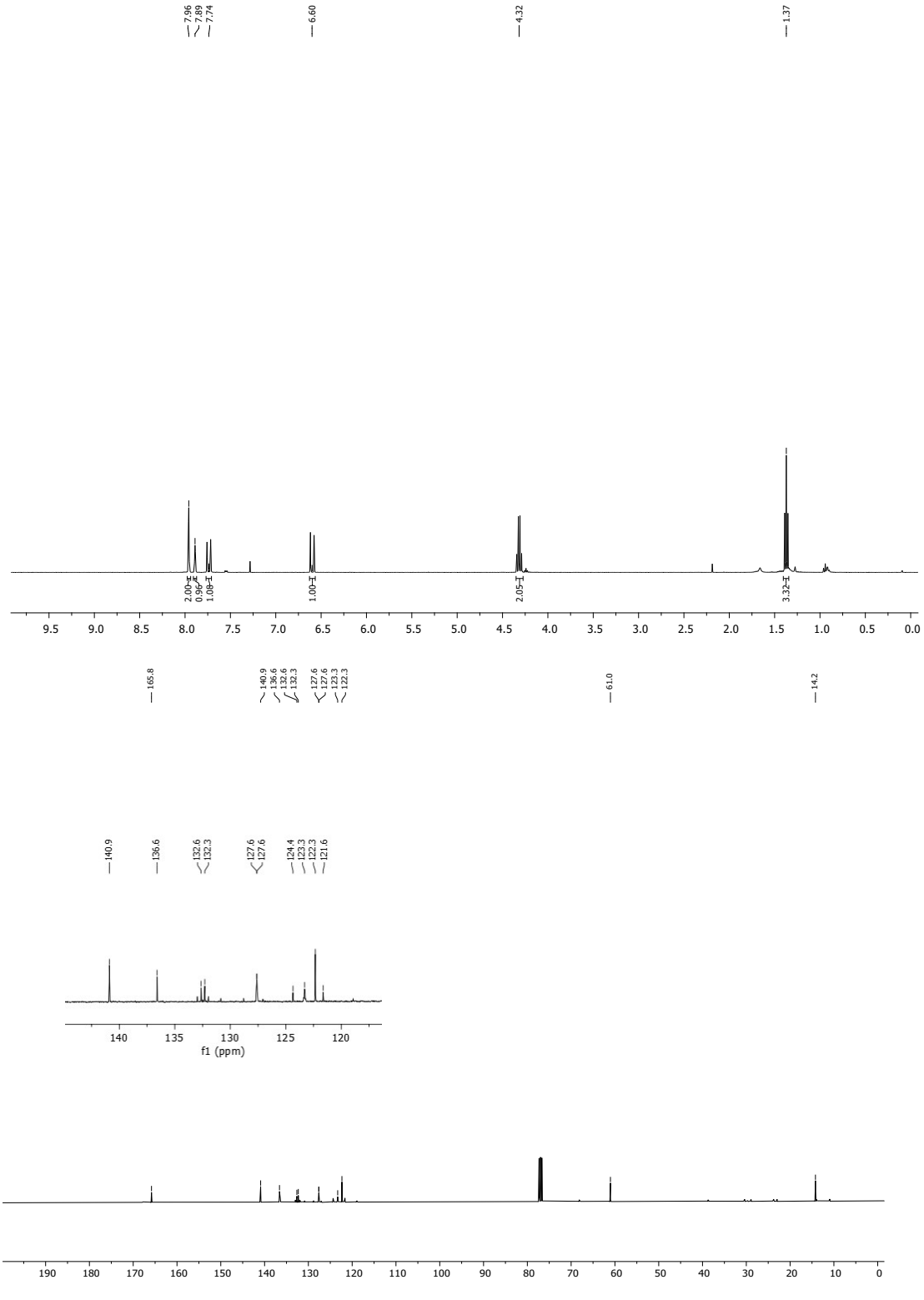

O
F3C
O
CF3

3l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7.89
7.74
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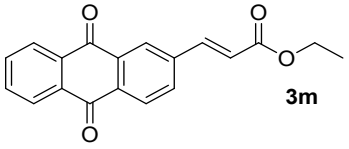
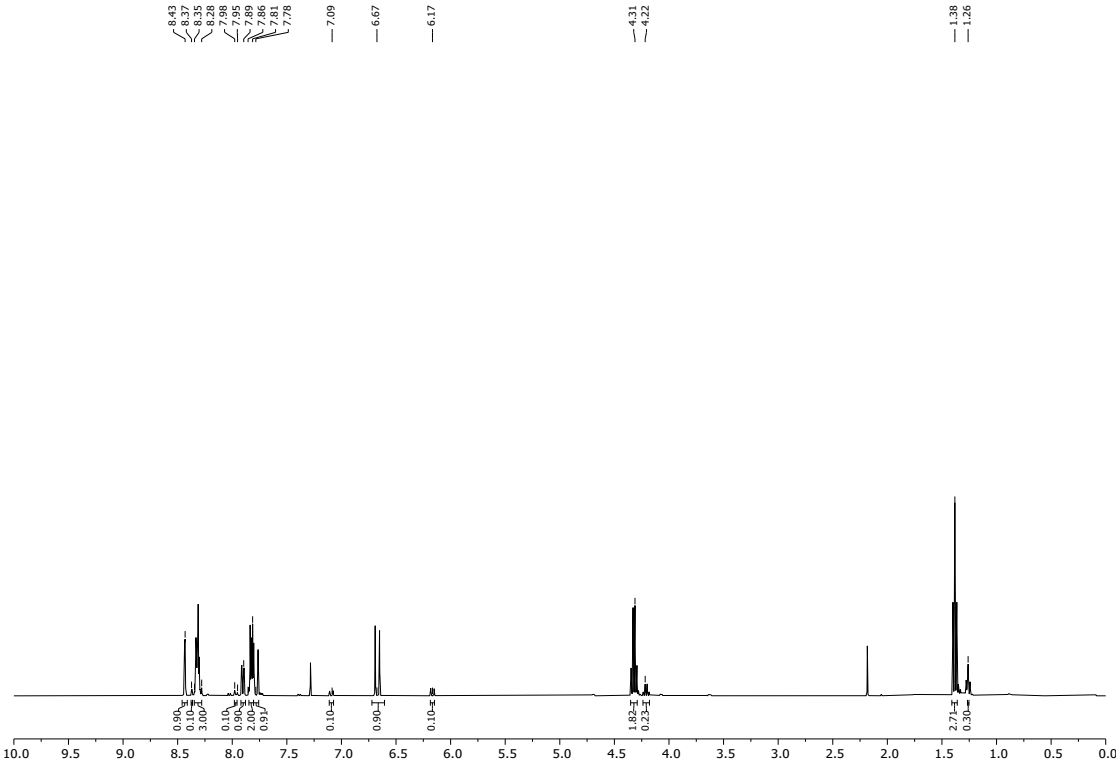
4.32
1.37
2.09
2.00
1.08
1.00
2.05
3.32
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
165.8
140.9
136.6
132.6
132.3
127.6
127.6
123.3
122.3
61.0
14.2
140.9
136.6
132.6
132.3
127.6
127.6
124.4
123.3
122.3
121.6
140 135 130 125 120
f1 (ppm)
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0


O
O
O
O

3m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7.95
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7.86
7.81
7.78
7.09
6.67
6.17
4.31
4.22
1.38
1.26
0.90
0.10
3.00
0.10
0.90
2.00
0.91
0.10
0.90
0.10
1.82
0.23
2.71
0.30
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
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4.5
4.0
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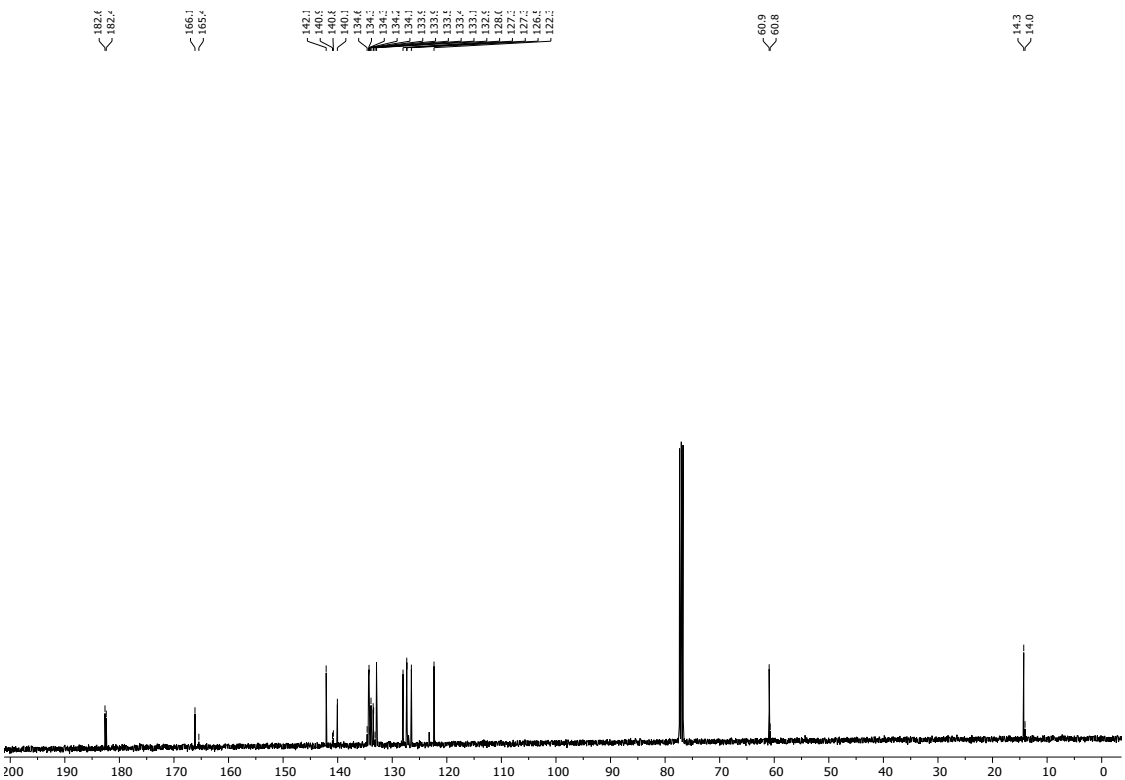
3.0
2.5
2.0
1.5
1.0
0.5
0.0


182.6
182.4
166.1
165.4
142.1
140.9
140.8
140.1
134.6
134.3
134.2
134.1
133.5
133.4
133.4
133.1
132.9
128.0
127.3
127.2
126.9
122.3
60.9
60.8
14.3
14.0
200
190
180
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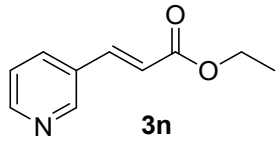
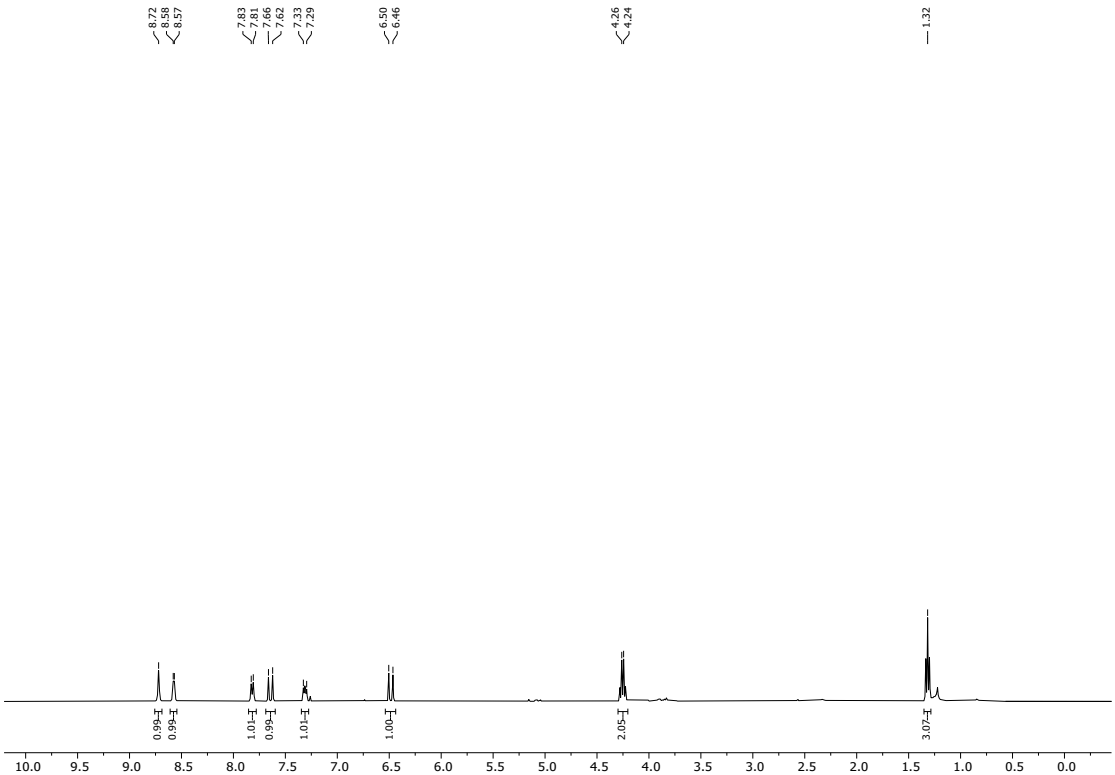
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0


O
O
N

3n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7.62
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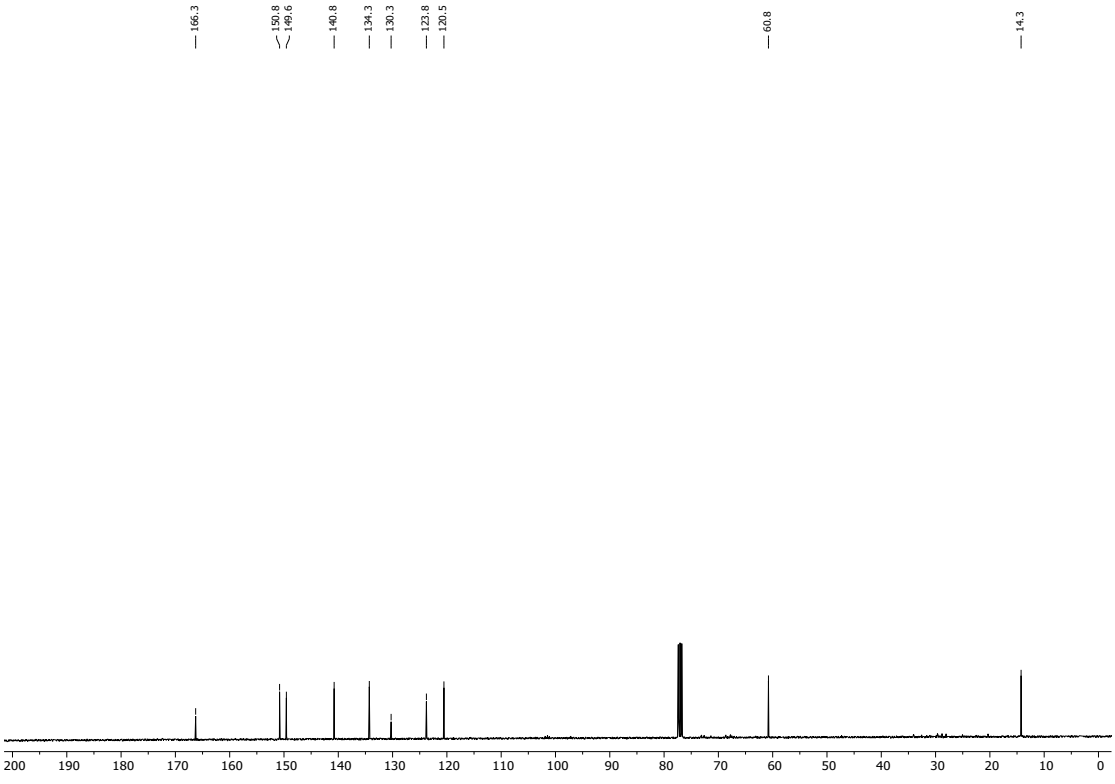
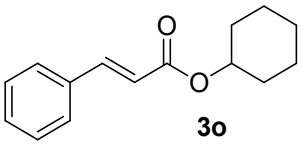
7.29
6.50
6.46
4.26
4.24
1.32
0.99
0.99
1.01
0.99
1.01
1.00
2.05
3.07
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0


166.3
150.8
149.6
140.8
134.3
130.3
123.8
120.5
60.8
14.3
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0



3o


7.71
7.57
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4.87
2.00
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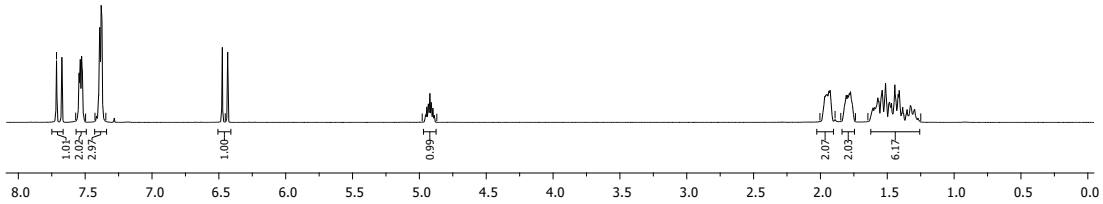
1.74
1.65
1.25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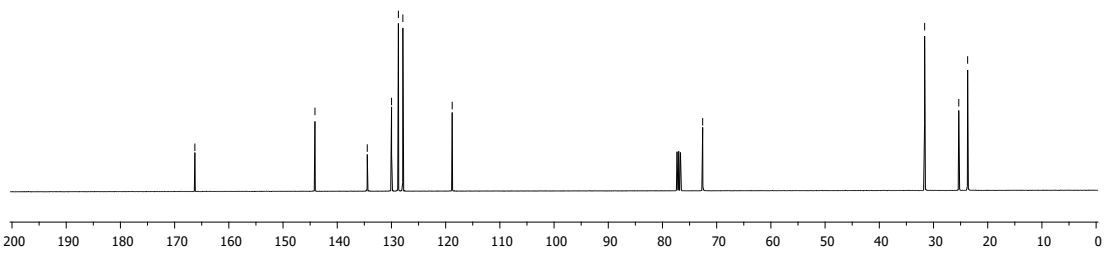
2.02
2.99
1.00
0.99
2.07
2.03
6.17
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0


166.3
144.1
134.5
130.0
128.7
127.9
118.8
72.6
31.6
25.3
23.7


200
190
180
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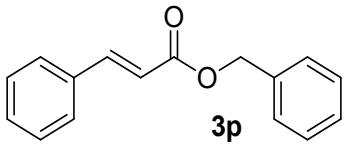
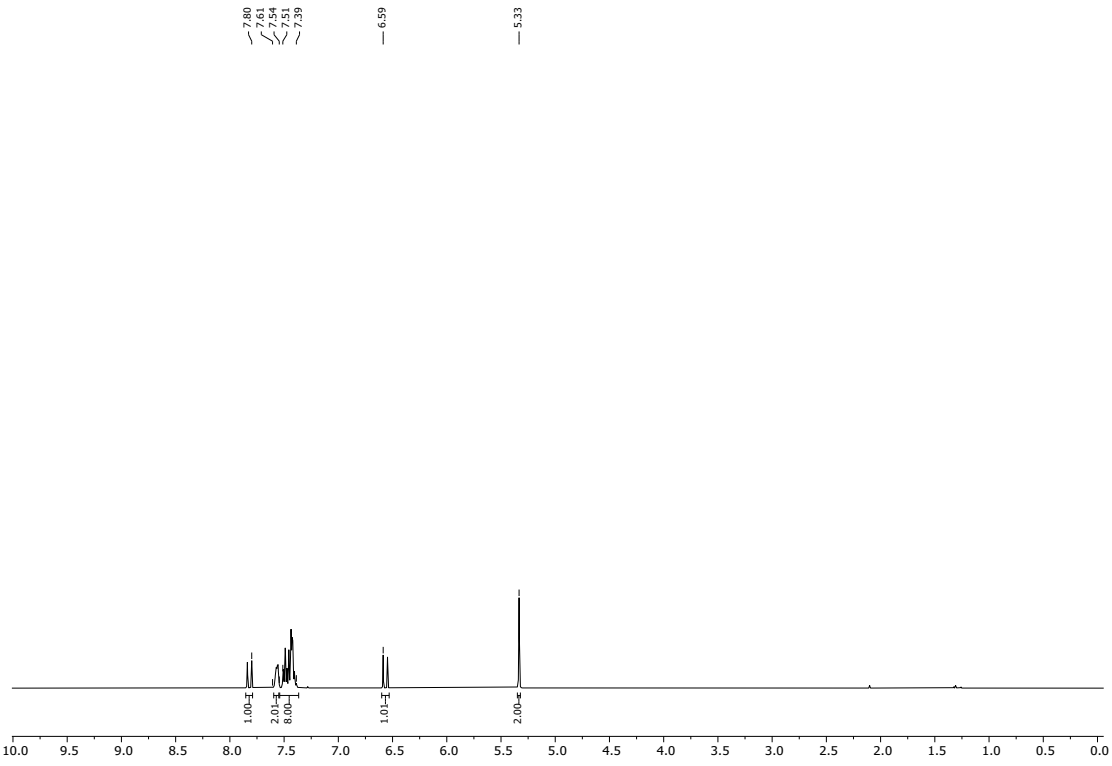
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0


O
O

3p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7.39
6.59
5.33
1.00
2.01
8.00
1.01
2.00
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
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4.0
3.5
3.0
2.5
2.0
1.5
1.0
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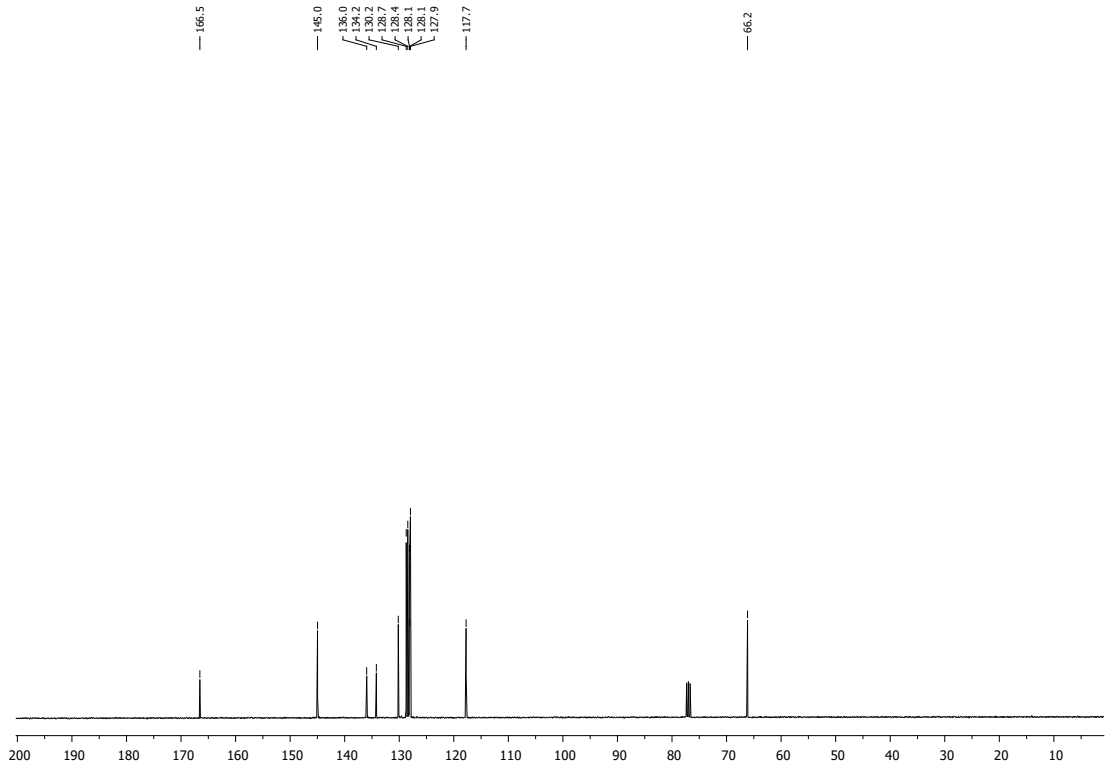
0.0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145.0
136.0
134.2
130.2
128.7
128.4
128.1
128.1
127.9
117.7
66.2
200
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120
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100
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80
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40
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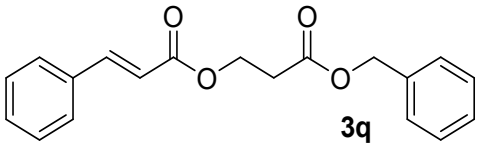
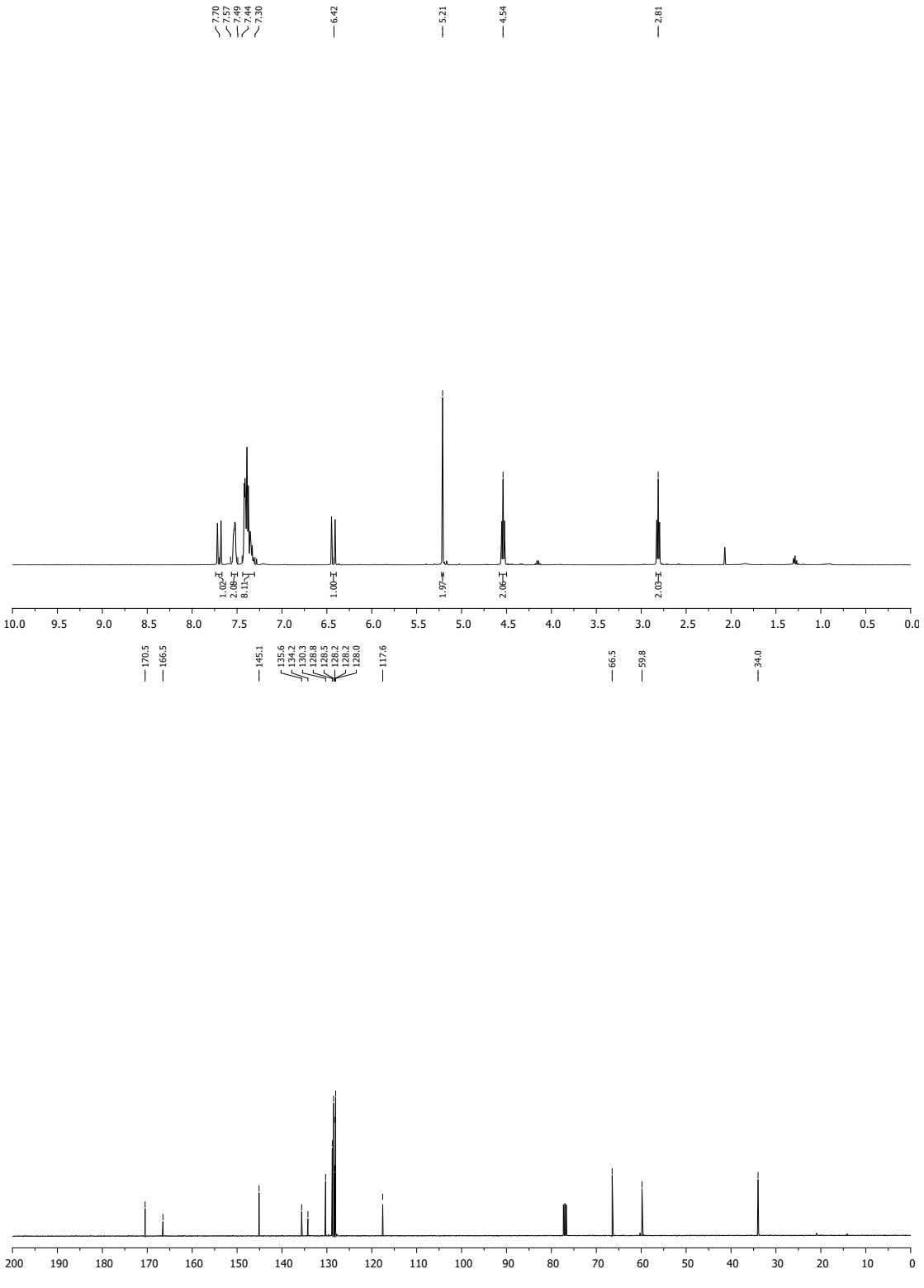
20
10


O
O
O
O

3q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6.42
5.21
4.54
2.81
1.02
2.08
8.11
1.00
1.97
2.06
2.03
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
170.5
166.5
145.1
135.6
134.2
130.3
128.8
128.5
128.2
128.2
128.0
117.6
66.5
59.8
34.0
200
190
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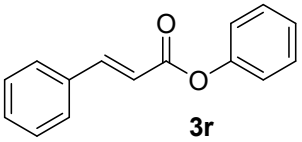
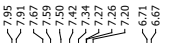
10
0



3r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7.20
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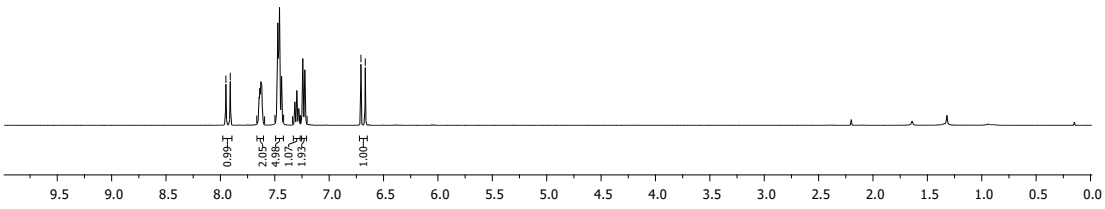
6.67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8.0
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7.0
6.5
6.0
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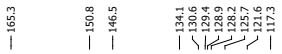
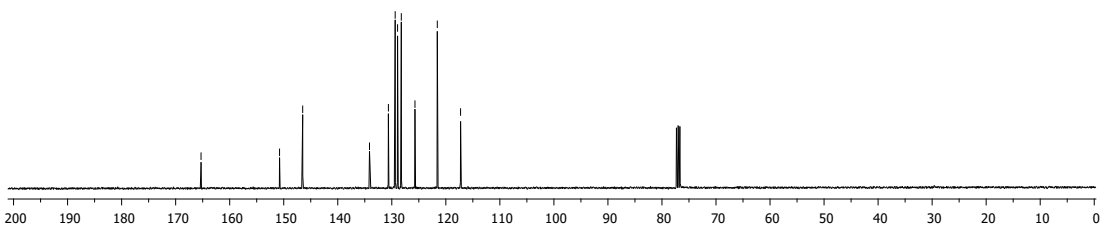

165.3
150.8
146.5
134.1
130.6
129.4
128.9
128.2
125.7
121.6
117.3


200
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180
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140
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120
110
100
90
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70
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50
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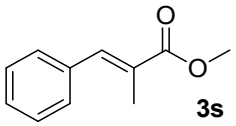
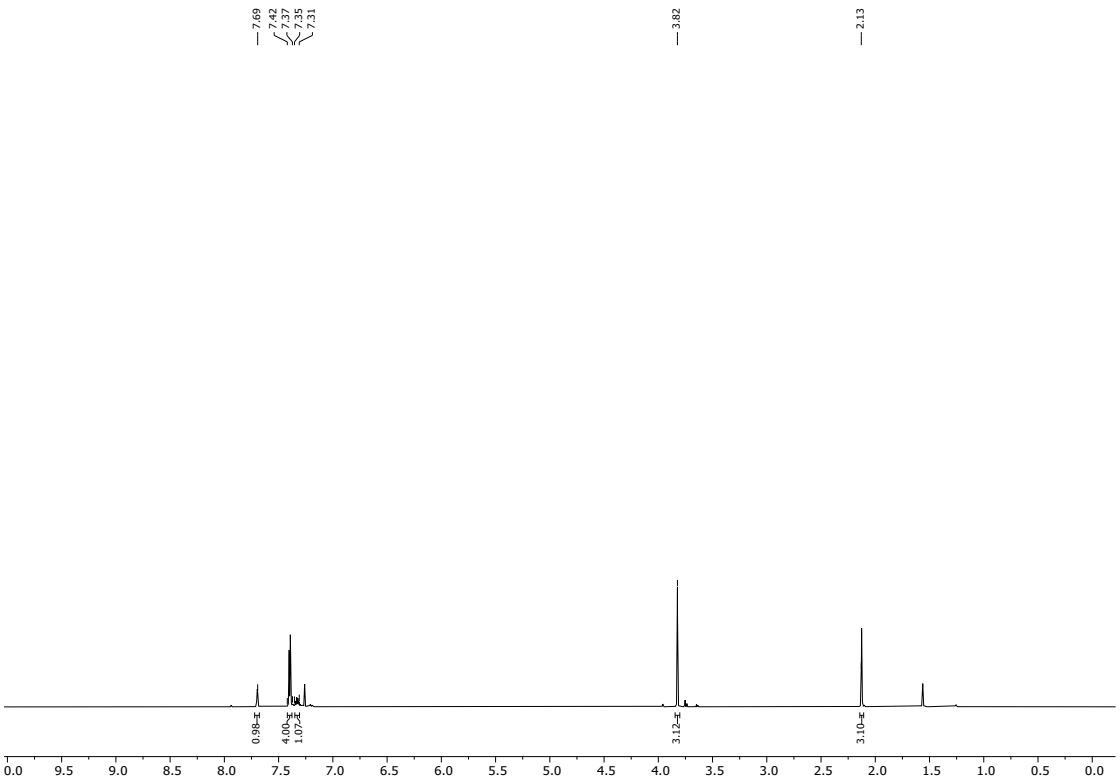
30
20
10
0



3s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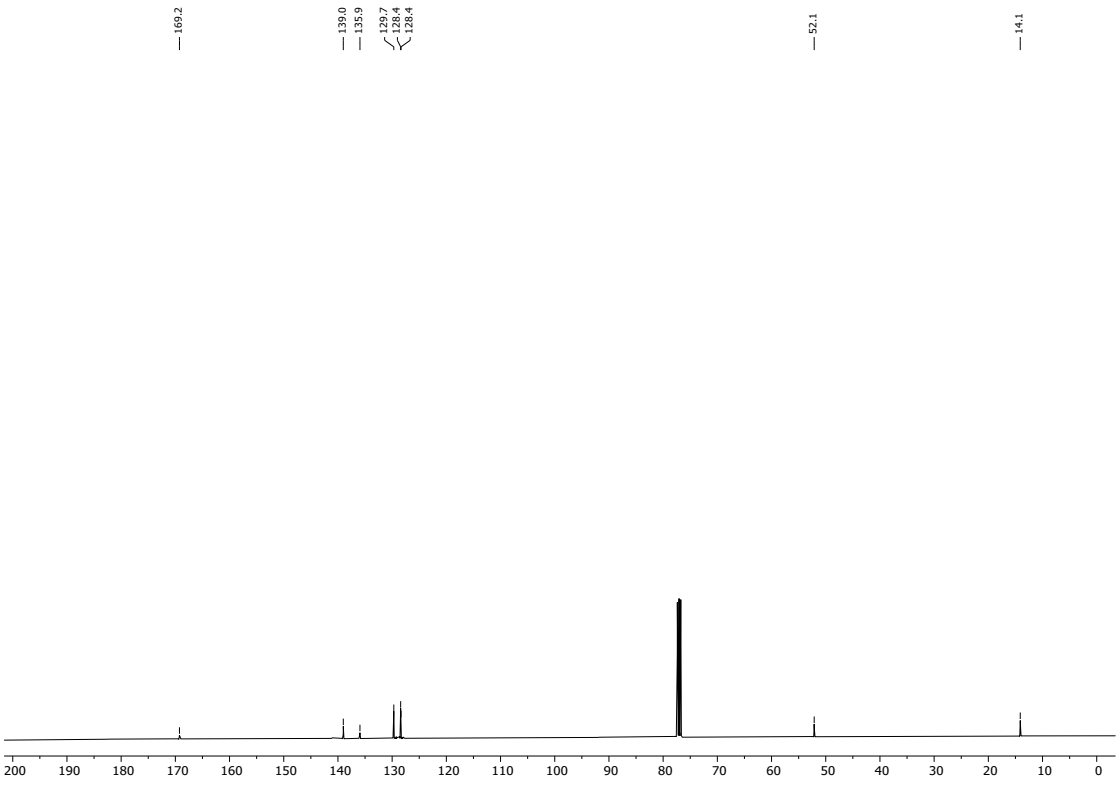
7.42
7.37
7.35
7.31
3.82
2.13
0.98
4.00
1.07
3.12
3.10
0.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0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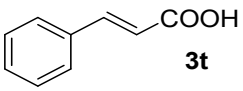
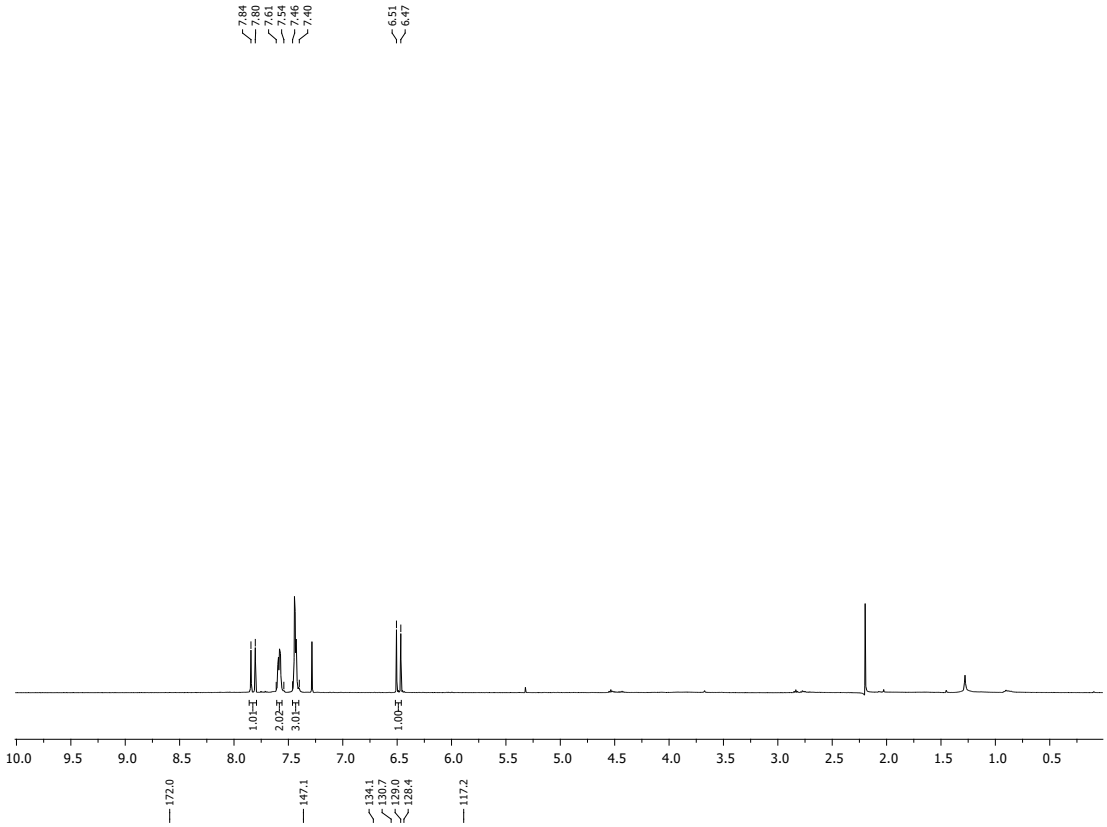
129.7
128.4
128.4
52.1
14.1
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0


COOH

3t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3.01
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7.0
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6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
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0.5
172.0
147.1
134.1
130.7
129.0
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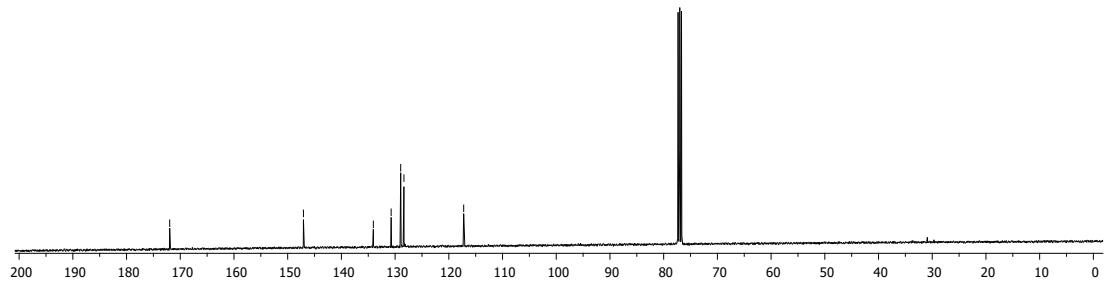
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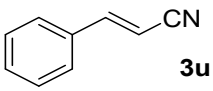
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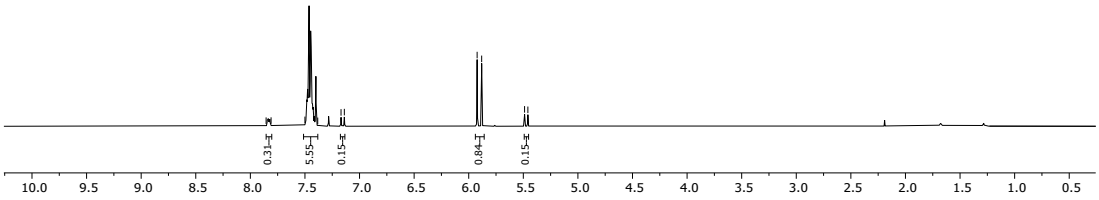
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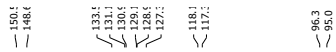
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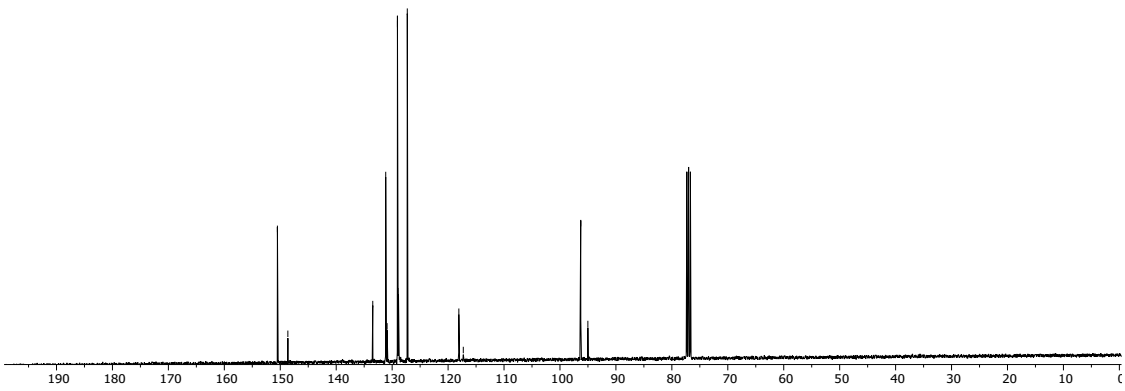
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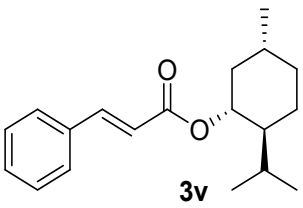
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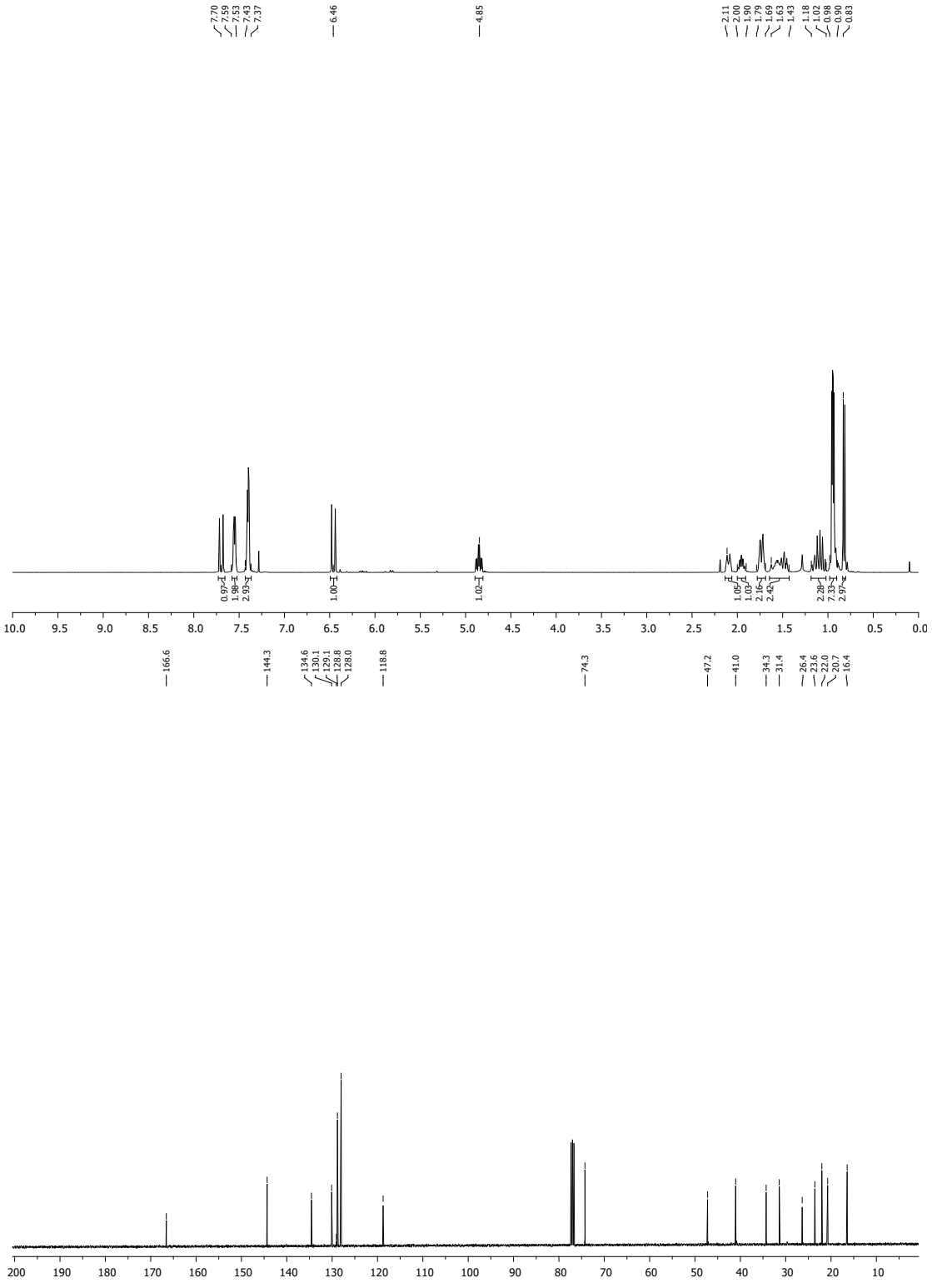
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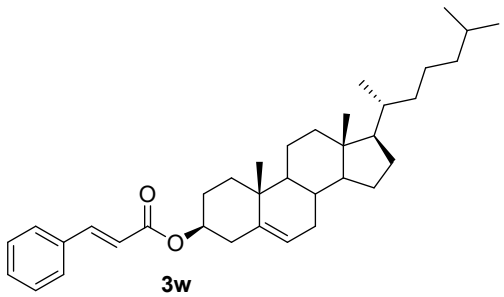
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3w


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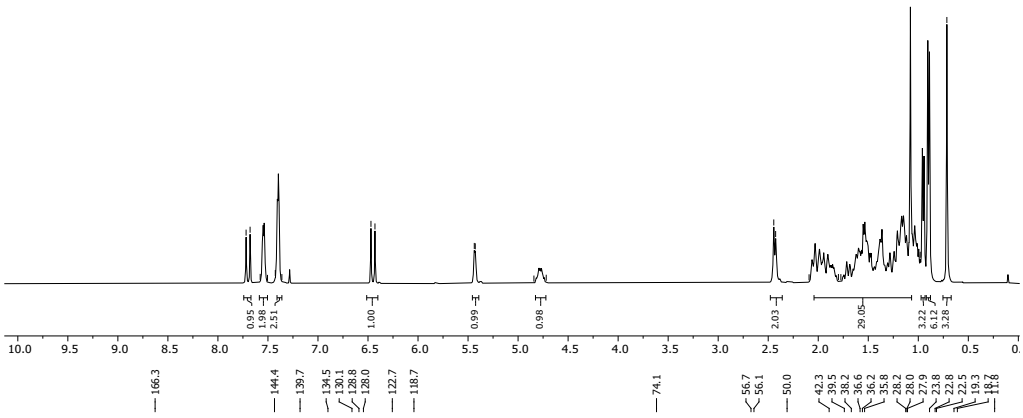
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144.4
139.7
134.5
130.1
128.8
128.0
122.7
118.7
74.1
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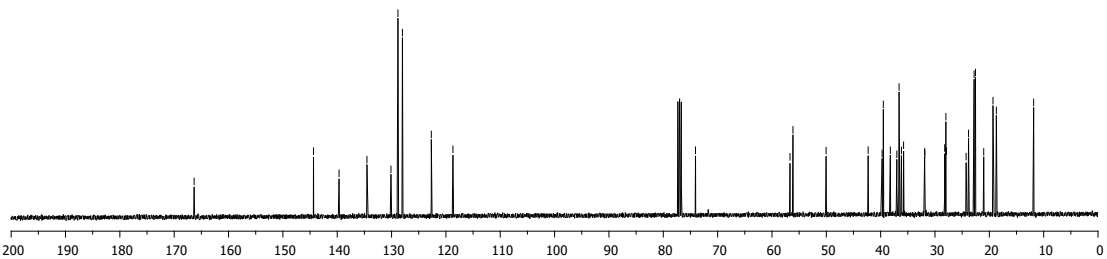
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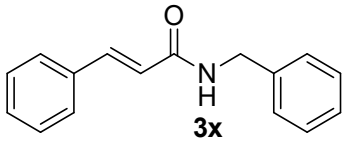
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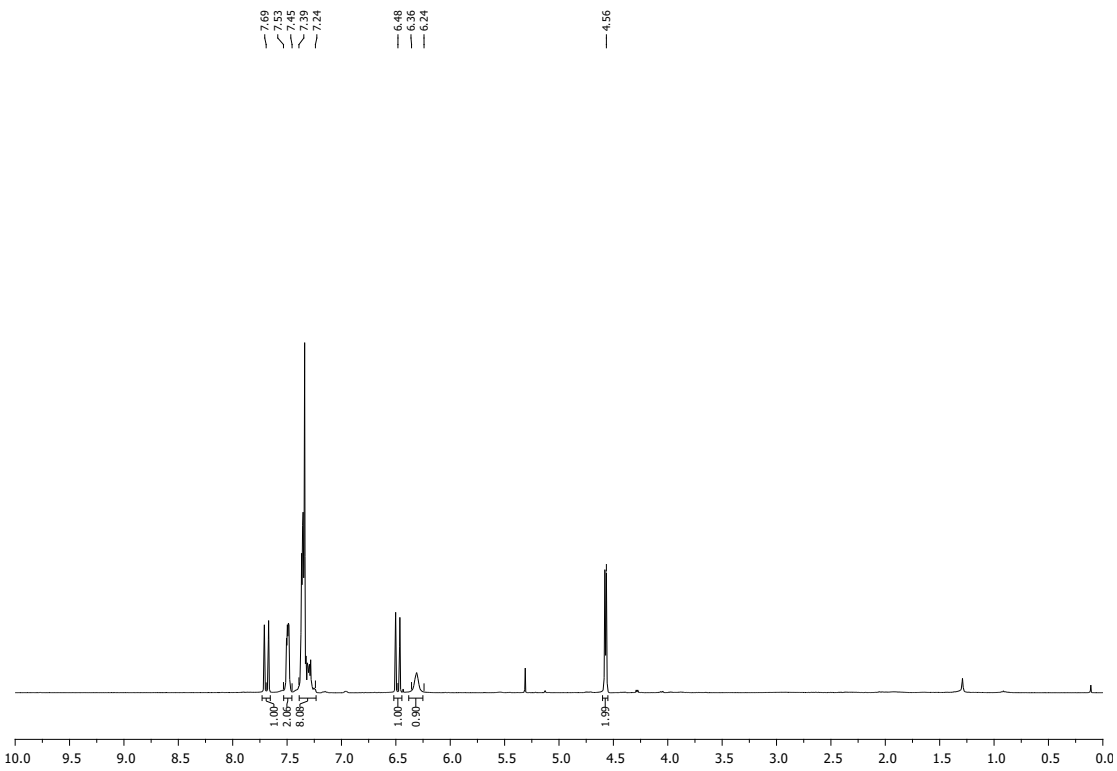
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8.0
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7.0
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6.0
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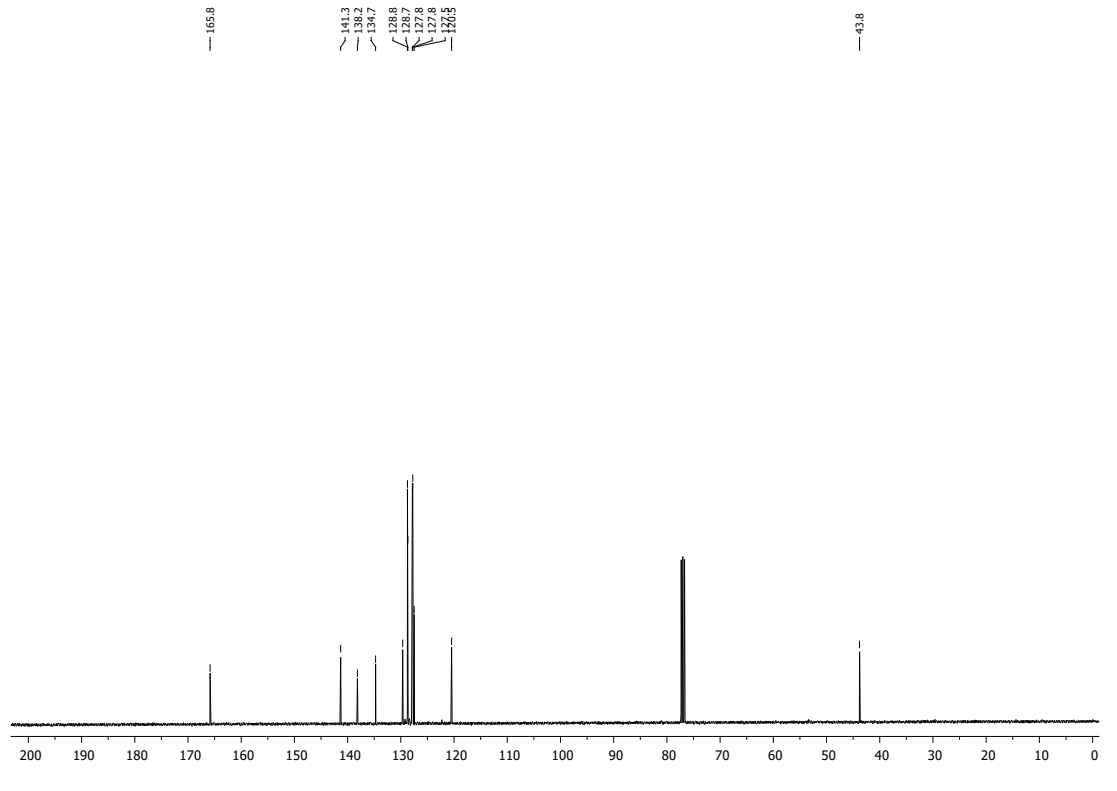
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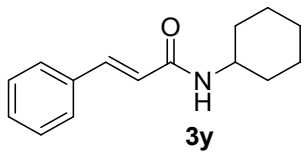
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N
H

3y


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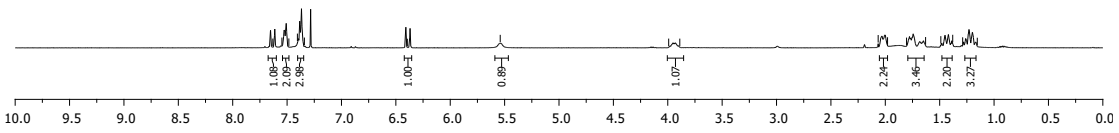
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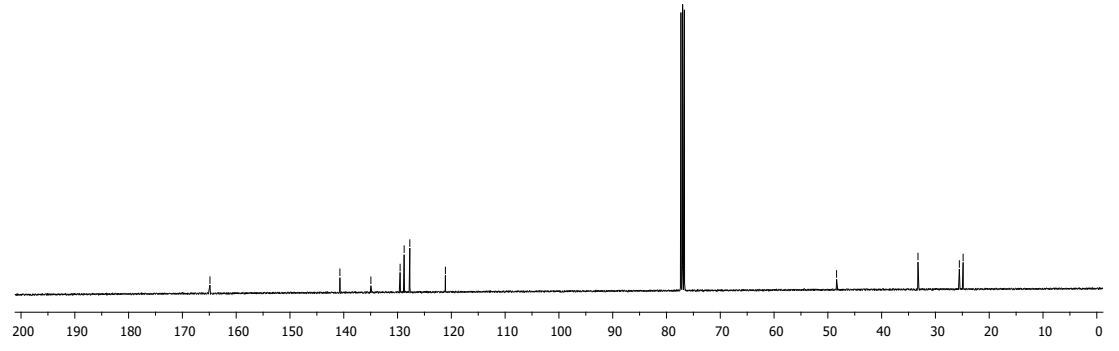
24.9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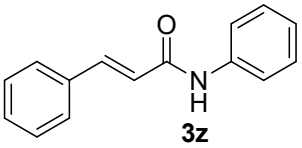
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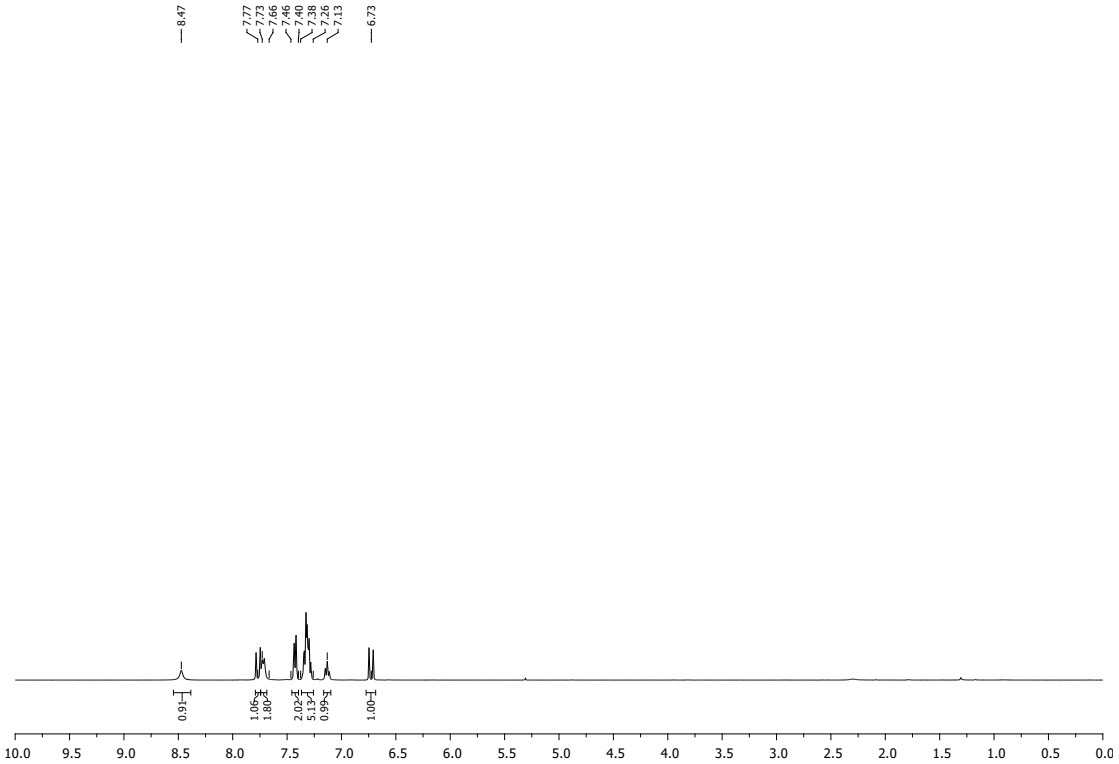
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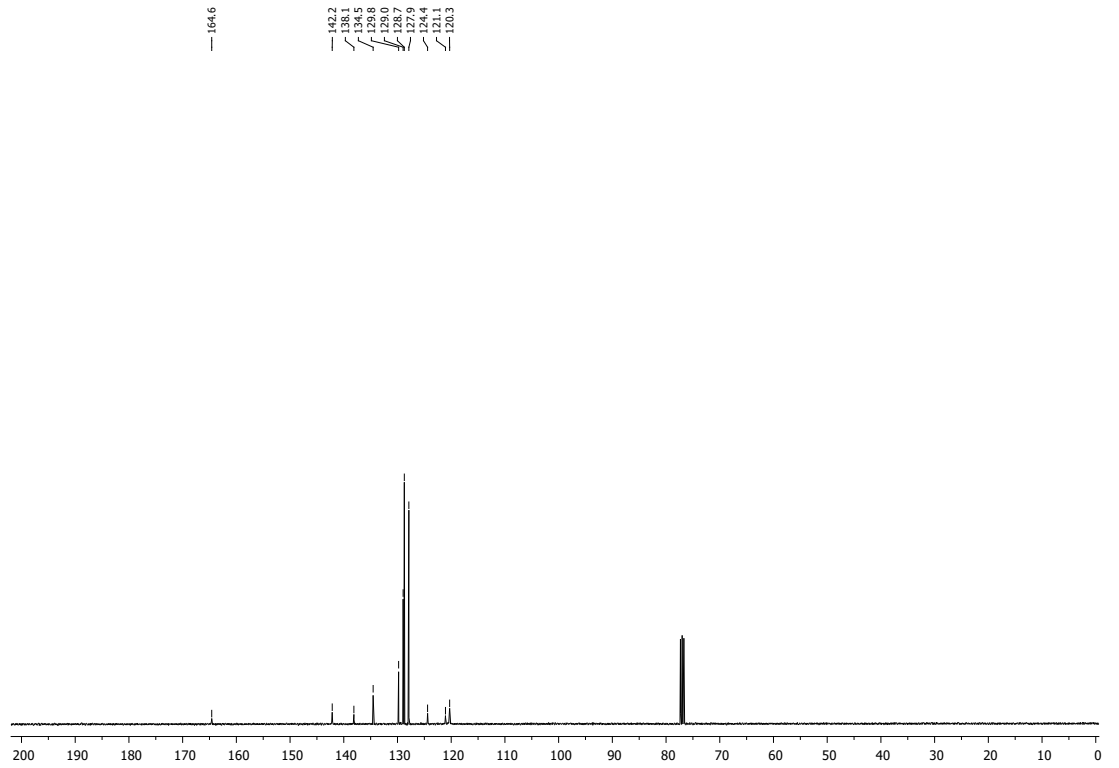
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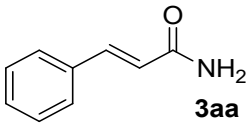
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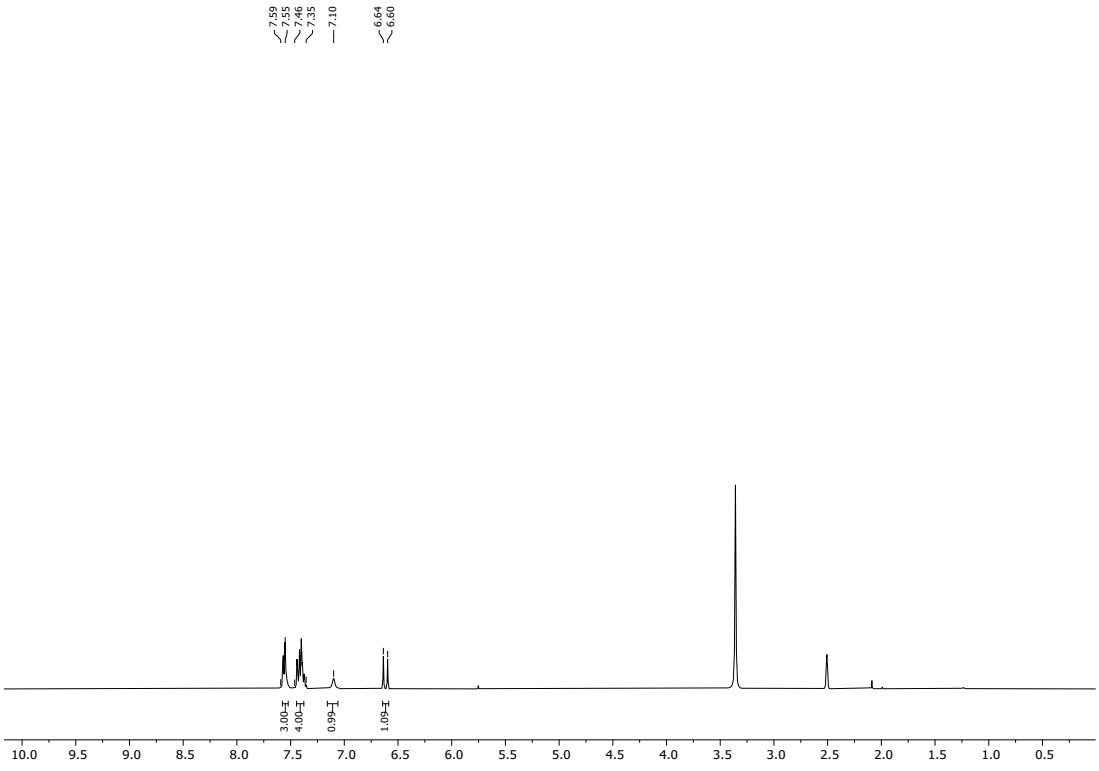
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1.09
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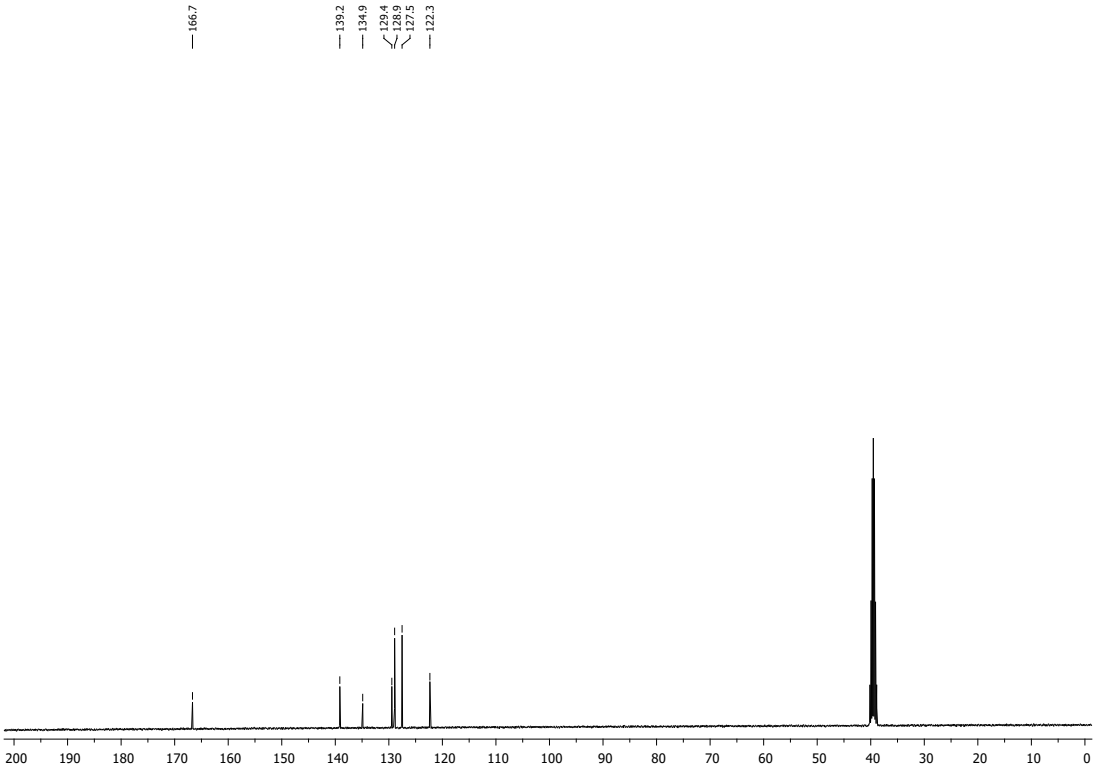
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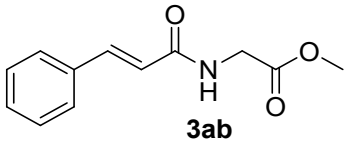
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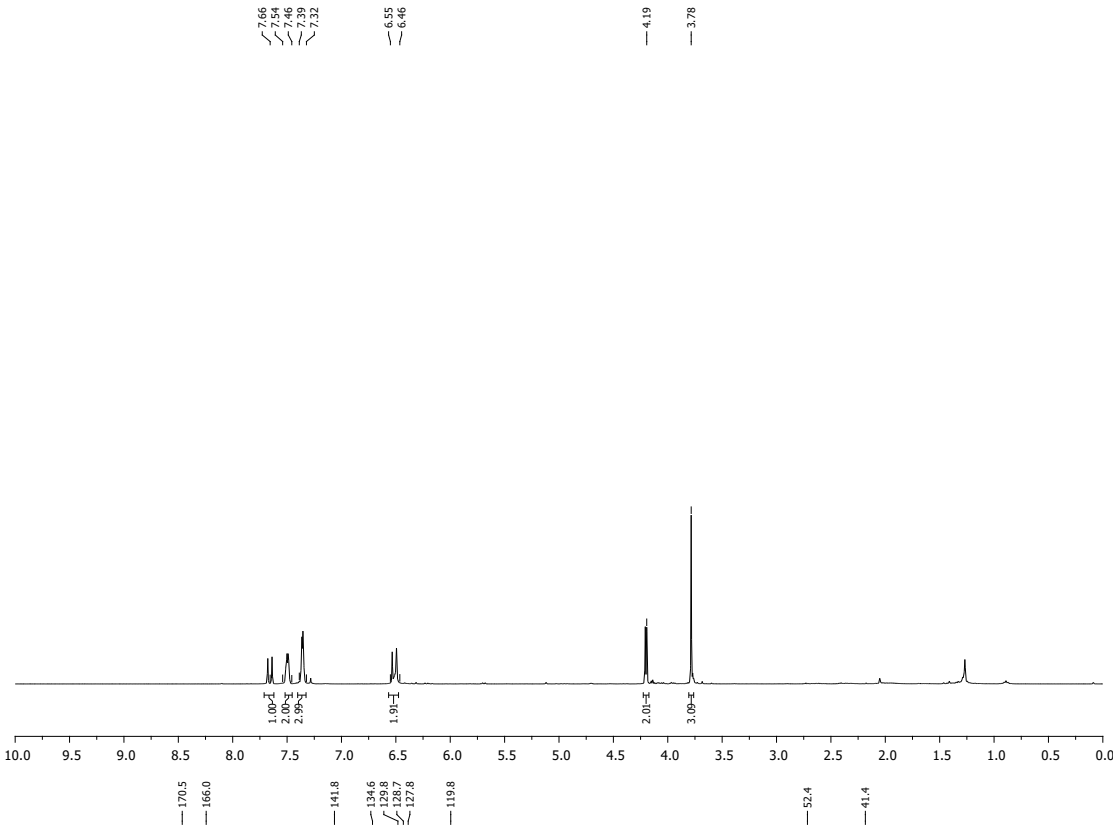
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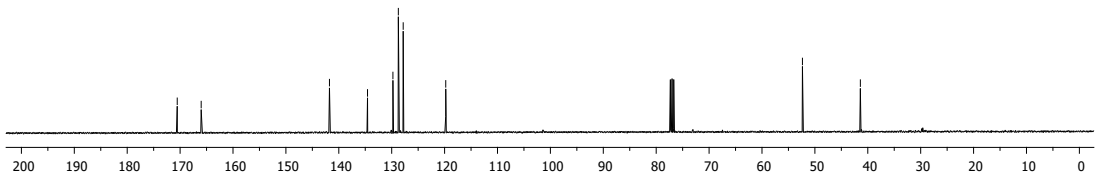
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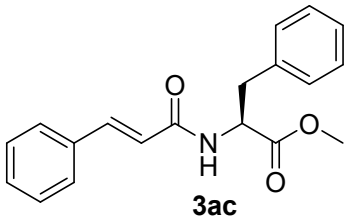
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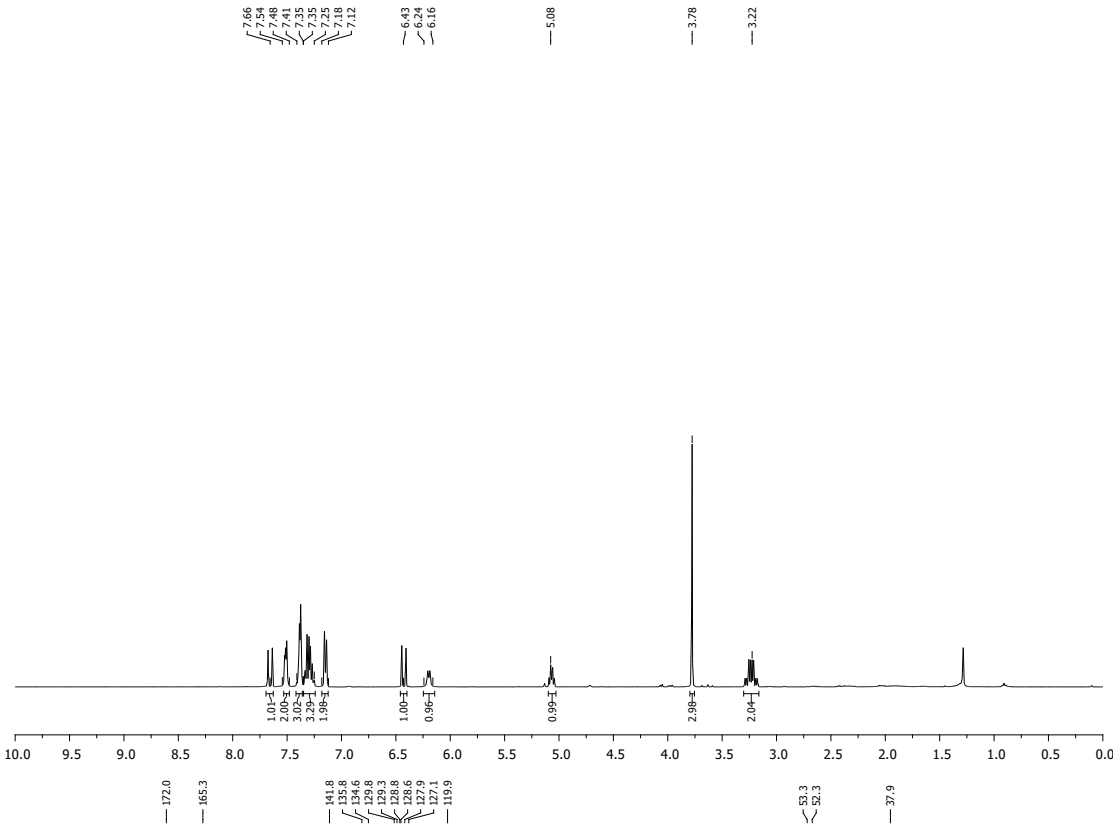
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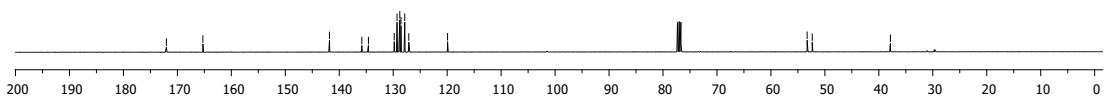
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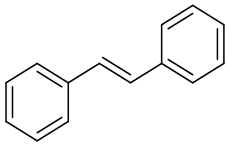

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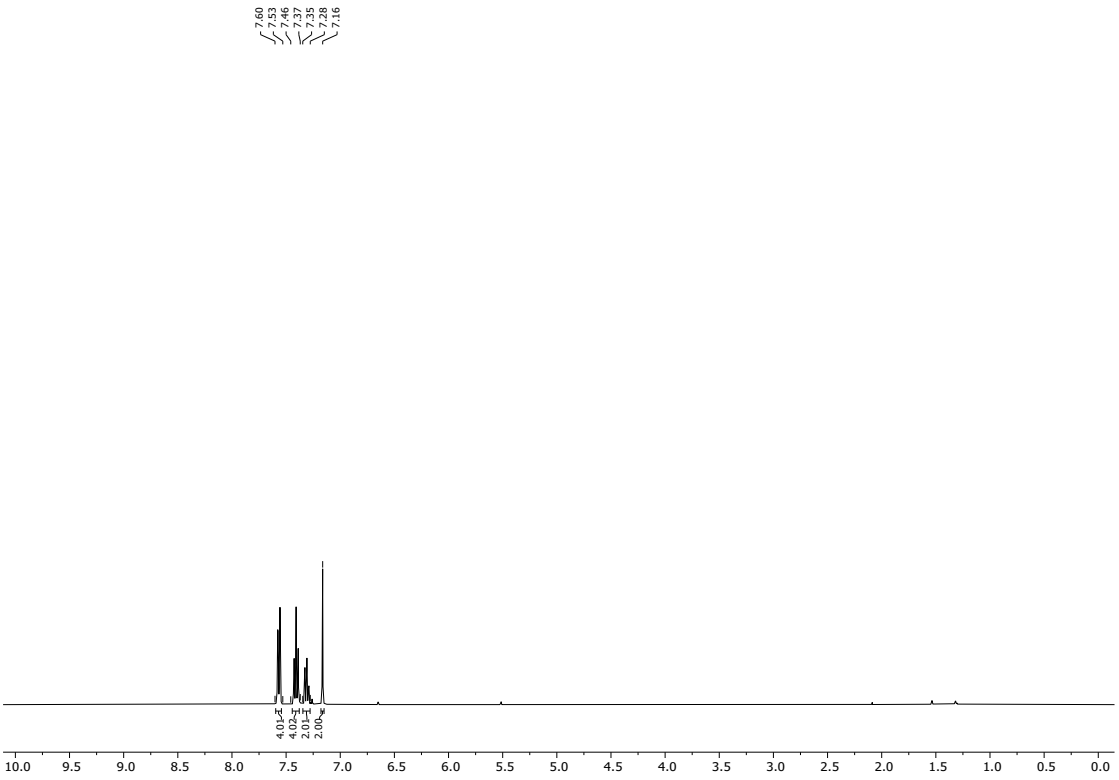
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2.01
2.00
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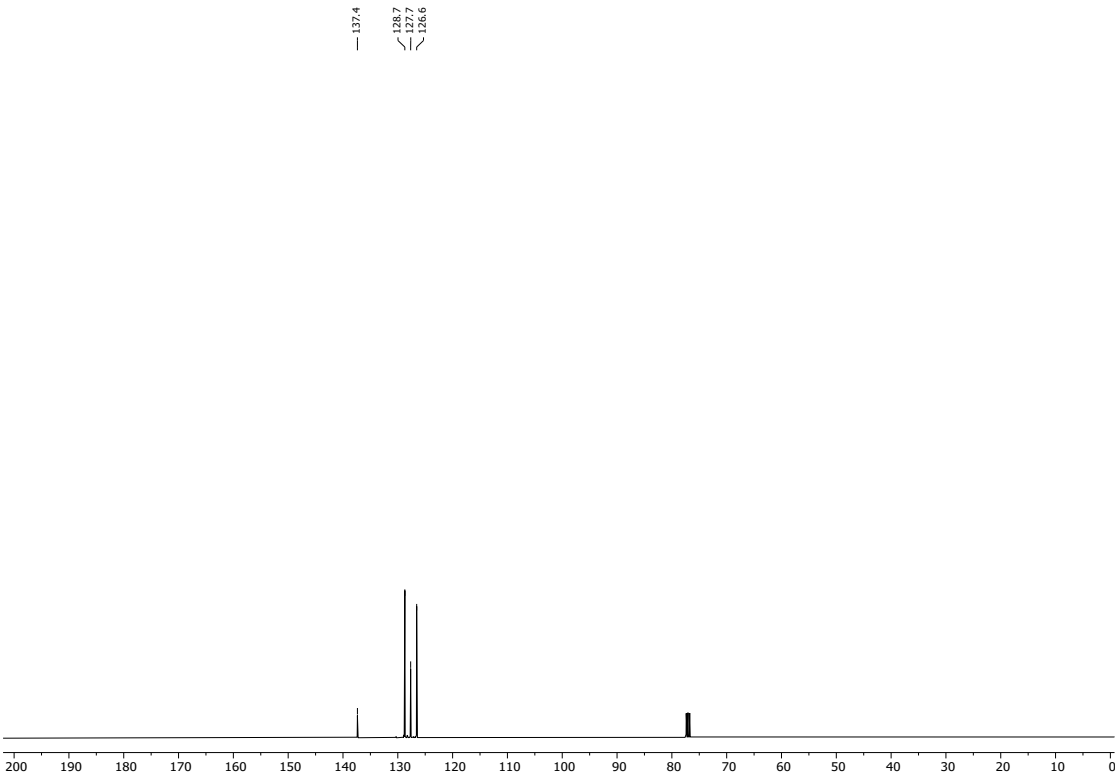
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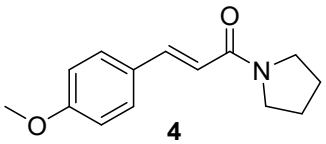

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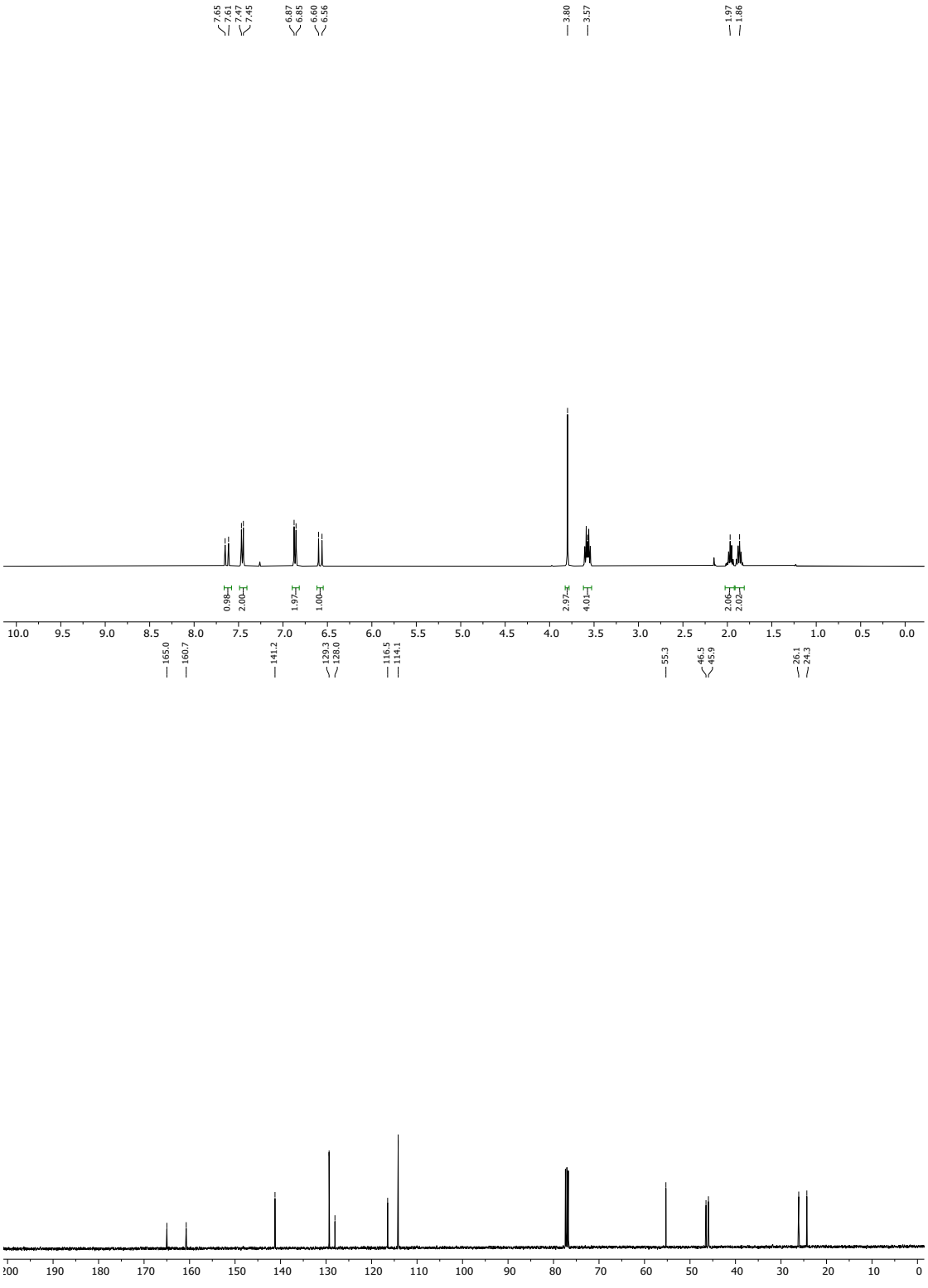
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1.00
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2.06
2.02
10.0
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128.0
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45.9
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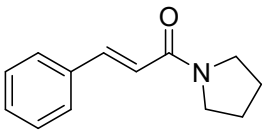

5


7.70
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6.74
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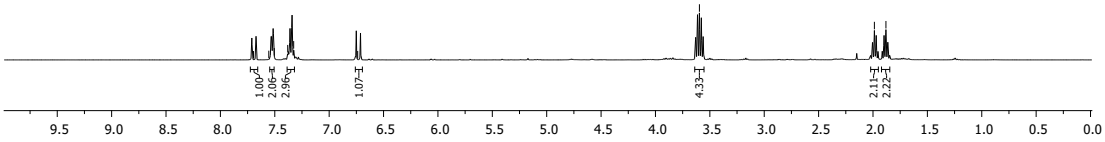
1.99
1.88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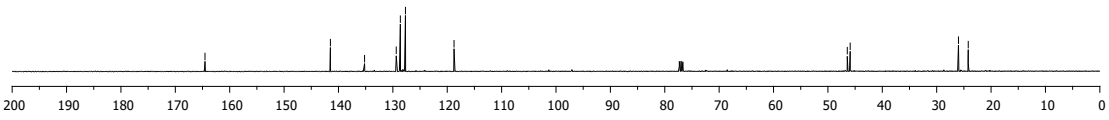
2.06
2.96
1.07
4.33
2.11
2.22
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0


164.5
141.5
135.2
129.4
128.6
127.7
118.8
46.4
45.9
26.0
24.2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